THE RAIN (REMOTE AUTOMATED INTELLIGENCE NETWORK) COMPUTER SYSTEM FOR SEED ORCHARDS

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Abstract.--RAIN is a computer network that monitors environmental variables and provides an electronic message system among users. Stations in the network use portable computers equipped with sensors that record local variables including temperature, leaf wetness, rainfall, wind speed and wind direction. These stations are highly reliable and very inexpensive. The network's central computer hub provides users with data bases, models and site-specific pest control recommendations. RAIN stations are in operation in more than twenty seed orchard sites throughout the eastern United States. The system is a useful tool for research and management. RAIN automatically advises managers when to spray insecticides to control the Nantucket pine tip moth (Rhyacionia frustrana Comstock). The recommendations are site-specific electronic messages based upon local temperature data collected by RAIN and on historical averages. Similar degree-day models are being developed to aid in the control of several cone and seed insects. Procedures have also been developed to use RAIN to collect pheromone trapping data from the Southwide coneworm survey.

Keywords: Temperature, rainfall, wind, Insecticides, Nantucket pine tip moth, coneworms, seed bugs, degree-day models.

RAIN is a network of on-site personal computers connected to a central hub consisting of two mini-computers located in the Entomology Department at the University of Georgia, Athens, GA. (Pickering et al. 1990). It monitors environmental variables and provides an electronic message system among users in both research and management. RAIN stations are installed at intensively managed agricultural and forestry sites throughout the southeast (Fig. 1). These stations link seed orchard managers with scientists, Forest Pest Management Specialists and Cooperative Extension personnel.

Each station in the network is an inexpensive portable computer, which is equipped with sensors that record local variables including temperature, leaf wetness, rainfall, windspeed and wind direction. Other types of sensors can also be added. Depending upon the variables monitored, each station costs $500 to $1500. Non-dedicated telephone lines are used for communication. Messages and sensor data are exchanged during unattended nightly telephone calls to the hub that take 1-3 minutes. Messages can be addressed to specific individuals who can save, delete, reply or forward them.

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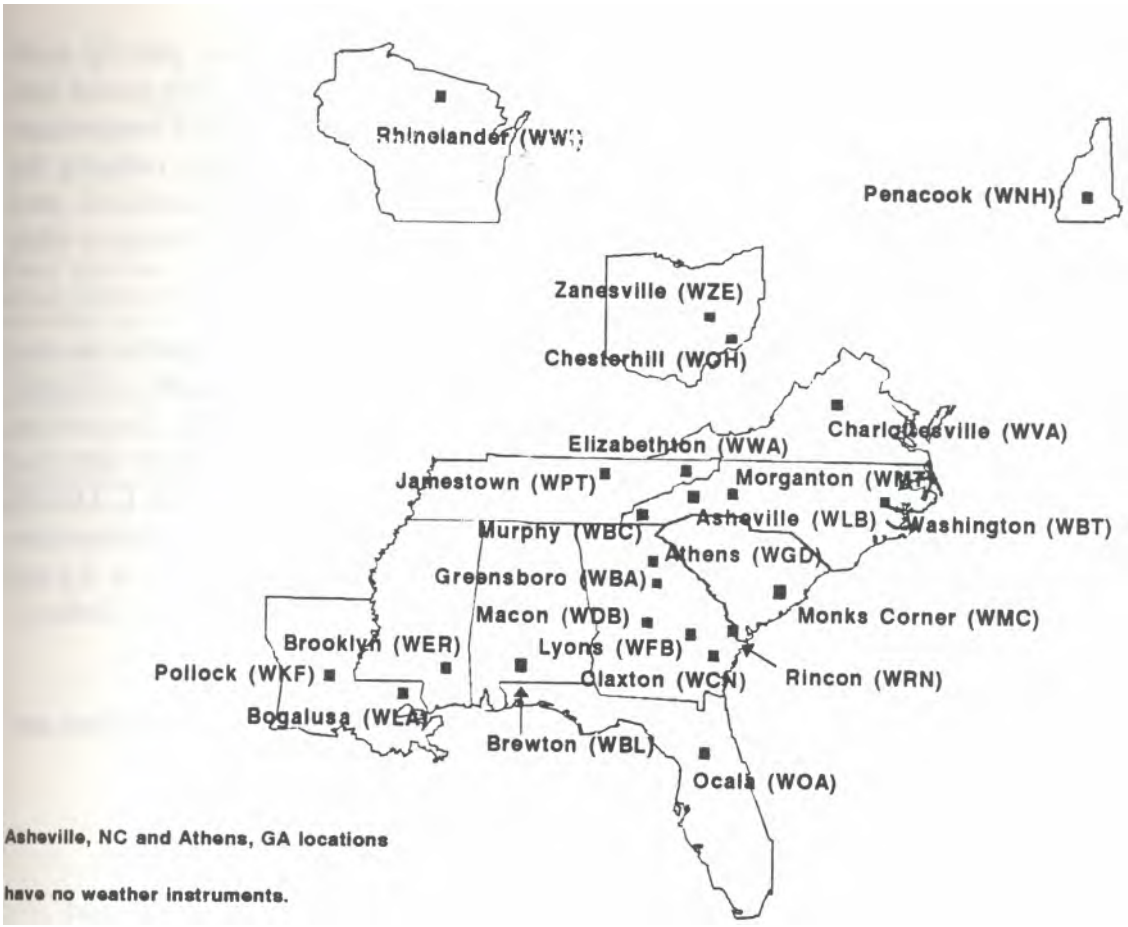

Figure 1. RAIN station locations at seed orchards in the eastern United States.

The network's central hub can provide users with databases, models and an expert system. The expert system sorts and forwards incoming information. Four types of information are collected from remote stations: (a) hourly sensor readings, (b) messages initiated by orchard managers (c) replies to electronic surveys sent from the hub, and (d) diagnostics. These data are accessible via microcomputers with modems and are used in both research and management.

We are developing RAIN for regional monitoring and management in forest tree seed orchards. Orchard management costs will be reduced by sharing data. Forest Pest Management specialists will be able to post electronic pest advisories based on historical data and up-to-date pest surveys. Procedures have been developed for incorporating the Southwide Coneworm Survey data into the Rain network (Mangini et al. 1993). This will eliminate the need for sending forms through the mail and automated database updates and summaries will be possible. Managers can forgo the use of pheromone traps until notified to start trapping for a specific coneworm species. They can be rapidly alerted to unusual pest outbreaks.

Currently, a temperature based phenology model for the Nantucket pine tip moth *(Rhyacionia frustrana* Comstock) is operational (Pickering et al. 1989). This model uses catches in pheromone traps, historic information on seasonal temperatures and temperature data updates collected by the network. It calculates optimal spray dates, thus reducing the number of chemical sprays required to protect progeny tests, newly established seed orchards or Christmas tree plantations. Short, site-specific messages advise managers when to apply insecticide to control this pest.

We plan to implement other pest models on RAIN. Threshold temperatures and degree-day estimates have been determined for the southern pine coneworm *amatella* Hu1st...) eggs (Hanula et al.. 1984) and larvae (Hanula et al. 1987). Degree-day models based upon these data have been field tested and resulted in control with two applications that was as good as that obtained with four monthly applications (G. L. DeBarr and J. L. Hanula--unpubl. data). Threshold temperatures and degree-day estimates have also been determined for the shieldbacked pine seed bug *(Tetyra bipunctata* H. & S.) and the southern pine seed bug *(Leptoglossus corculus* Say) (J. C. Nord and G. L. DeBarr--unpubl. data).

RAIN a reliable, inexpensive computer network . It has many valuable functions and will serve as the keystone for future pest management systems in seed orchards.

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