Table 1. Virus symptom expression on indicator hosts inoculated with papaya mosaic virus.

Indicator Host	Days for symptom expression	Symptom expression
Carica papaya	9	Chlorosis
Gommphrena globosa	5	Chlorotic
Chenopodium quinoa	14	Necrotic lesions
Nicotiana benthamiana	14	Chlorosis which coalesced
Havana 423	14	Chlorosis
Cucumis metuliferus	0	No symptoms
Cucurbita pepo	0	No symptoms

isolates collected from a number of different countries. However, there were clear precipitin lines with the antisera to PMV and the infected tissue from *Gomphrena* and *N. tabacum* 'Havana 423'. There was no reaction between this antiserum and PRV HA 5-1-infected tissue.

Where this virus may have been residing for the past 27 years is not known. How it reached Pine Island is not known, but ornamental and tropical fruit plants have made their way to the area from southern Dade County area over the past 70 years. Mangos were planted on the island in the late 1920s. This the first report of papaya mosaic in papaya plants from Pine Island. Townsend and Andrews (1940) reported virus-like symptoms in Florida papayas but they never demonstrated the viral nature of the disease. Harkness (1900) at the Subtropical Experiment Station, Homestead, Fla. recognized papaya viruses as a limiting factor in papaya production in Florida. Conover (1964) proved the viral nature of the papaya virus diseases in South Florida and showed that papaya mosaic potexvirus could not be transmitted by aphids but could be easily transmitted to host plants by mechanical means. Conover (1964) and Cook (1972) reported numerous alternate hosts, such as other species of *Carica, Catharanthus rosea* and *Zinnia elegans*. All of these plants were grown in South Florida going back to the early 1900s, and could have been introduced to the island by its inhabitants.

We hope this outbreak of papaya mosaic was confined to this single papaya planting which has since been destroyed, and will not occur in future papaya fields. However, an effort should be made to determine if papaya mosaic potexvirus is in alternate hosts on Pine Island since a new planting of papaya is being set out at this time. Great care should be taken to not infect the new planting with this virus. Maintenance of a virus-free planting is possible with good sanitation practices. Planting and harvesting crews should be required to maintain virus-free hands by washing with soap and water.

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WATER USE AND IRRIGATION SCHEDULING OF YOUNG BLUEBERRIES

R. T. Pritchard, D. Z. Haman, and A. G. Smajstrla
Agricultural Engineering Dept.
IFAS, University of Florida
Gainesville, FL 32611

P. M. Lyrene
Fruit Crops Dept.
IFAS, University of Florida
Gainesville, FL 32611

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Abstract. **Results of a study of blueberry growth during the first three years after transplanting are presented. Two-year-old container-grown rabbiteye (*Vaccinium ashei* Reade), and highbush (*Vaccinium corymbosum* L.) blueberry plants were grown in a field lysimeter system at Gainesville, Fla. Treatments consisted of irrigation scheduled at 10 kPa, 15 kPa, and 20 kPa soil water tensions with pine bark mulch as ground cover. The 10 kPa treatments exhibited the highest growth rate and required the most irrigation. The rabbiteye displayed a more vigorous growth than the highbush. The highbush variety exhibited more sensitivity to soil water depletion than the rabbiteye.**

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Blueberries have shown much promise as an alternative crop in Florida. The importance of irrigating young blueberry plants has been recognized for some time and is documented throughout the literature. In dry years, irrigation is very important during fruit formation and fruit sizing. It has been shown (Buchanan et al., 1978) that yield and berry size can be increased by 20% to 25% with drip irrigation in a dry year and that a drip irrigation system would pay for itself in one year at the market prices at that time. In addition, rainfall in Florida is typically low during the time of blueberry bud formation, and sufficient water supply at this time is critical for the next year's crop (Lyrene and Crocker, 1991).

Microirrigation (formerly drip or trickle) allows direct water application to the root zone of the crop, and the amount of water can be precisely controlled to minimize application losses. In Florida's sandy soils with low water holding capacities and large pore spaces (capillaries), water application must be frequent and relatively small to avoid water losses from the root zone to deep percolation. This requires precise irrigation scheduling.

Recently, research was conducted at the University of Florida using drainage-type lysimeters to determine the effects of irrigation scheduling and mulch on the growth of young container-grown rabbiteye and highbush blueberry plants (Haman et al., 1988). The control of a microirrigation system using magnetic switching tensiometers was evaluated for irrigation scheduling of blueberries by Smajstrla et al. (1988). The objective of this research was to determine vegetative growth response of two types of blueberry (*Vaccinium*), highbush and rabbiteye, to three different levels of soil water tension, 10 kPa, 15 kPa, and 20 kPa, during the first three years after transplanting.

Materials and Methods

The study was conducted in a field lysimeter system at the IFAS Irrigation Research and Education Park in Gainesville, Fla. Details of the lysimeter construction were given by Smajstrla (1985). Three-year-old container-grown 'Sharpblue' (highbush), and 'Powderblue' and 'Premier' (rabbiteye) blueberry plants were used in this work. Two blueberry plants were grown in each of 24 drainage-type lysimeters, a total of 48 plants (Fig. 1). Blueberries were grown following typical Florida production practices.

A spray-jet microirrigation system was used in this study. Treatments consisted of irrigation at soil water tensions of 10 kPa, 15 kPa, and 20 kPa. Water was supplied to the plants using an automatic control system, utilizing switching tensiometers to interrupt the signal which controls the opening of an irrigation solenoid valve for any row in which the signal indicated an excessive soil water tension.

The vegetative plant growth was calculated from three dimensional measurements: height, and two perpendicular widths for a cylindrical volume. Measurements were taken on monthly intervals.

Results

This report presents the vegetative growth versus irrigation for the two varieties and three irrigation treatments over three growing seasons from 1991 to 1993.

Reference evapotranspiration. Weather data from the on site automatic weather station were used to calculate monthly reference evapotranspiration (ETo) using Penman's method (Fig. 2). This method best reflects Florida's humid climate which generally results with the highest ETo in May, June, and July. The seasonal patterns of high ETo during the growing season and reduced ETo during the winter are well defined. This is consistent with the solar radiation and temperature patterns which are the dominant variables in Penman's ETo equation. To a lesser degree, relative humidity and wind speed also play a role in climatic demand.

Rainfall. Long-term monthly average rainfall values are presented in Fig. 3. Monthly rainfall values are presented along with the irrigation values.

Irrigation. Irrigation values are presented as a cumulative depth in mm based on a production area of 1492 plants per hectacre. The variation in irrigation requirements reflect the respective treatments of 10, 15, 20 kPa, the seasonal ETo patterns, and the rainfall variation accordingly.

Fig. 4 shows the three cumulative irrigation amounts for the three rabbiteye treatments. The 10 kPa treatment consistently required more irrigation than the 15 and 20 kPa treatments and has maintained approximately double the requirement of the 20 kPa. Over the years, the 15 and 20 kPa treatments have required similar amounts of irriga-

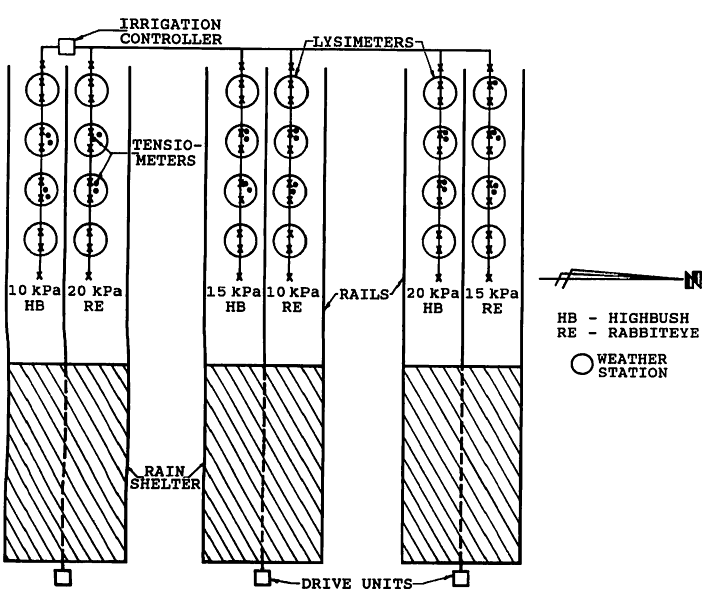

Figure 1. Layout of field experiment.

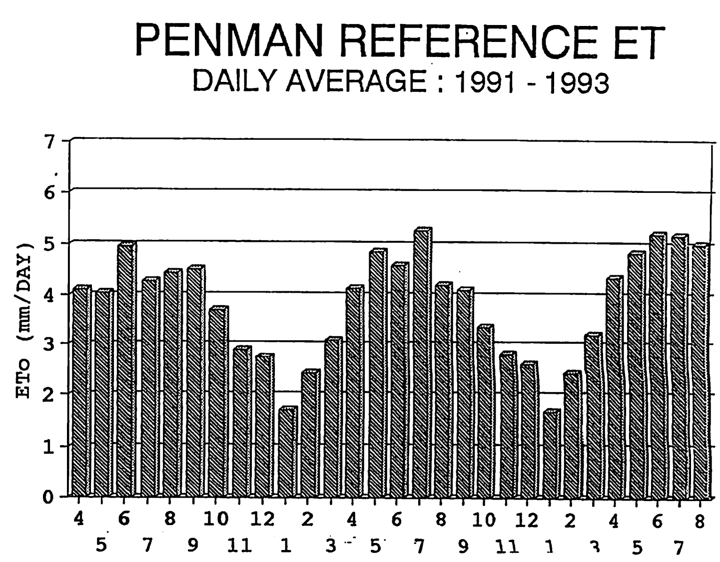

Figure 2. Annual distribution of Penman reference ET.

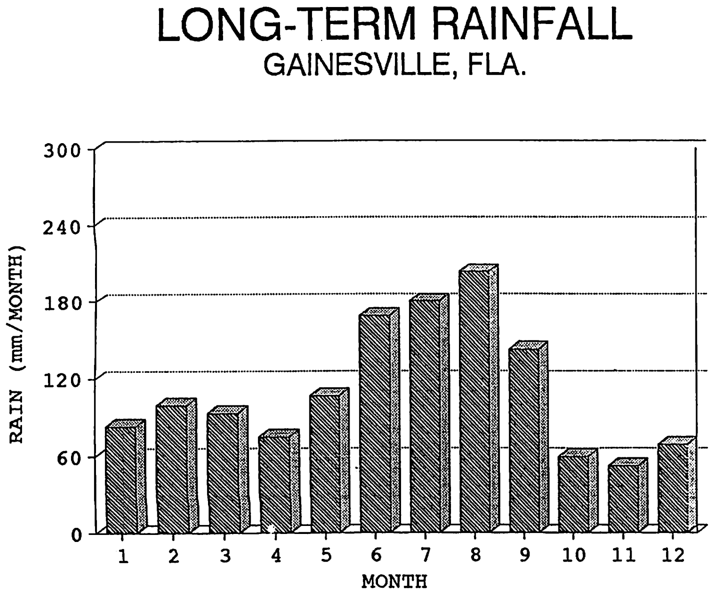

Figure 3. Annual distribution of average rainfall.

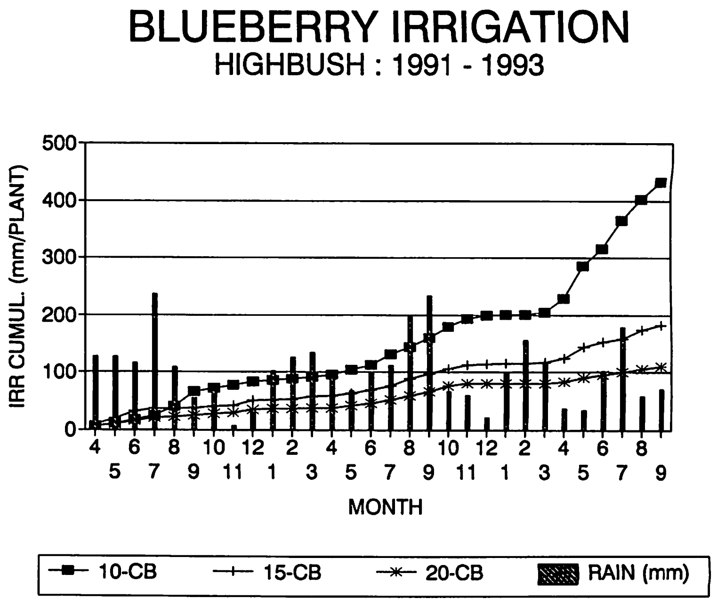

Figure 5. Irrigation requirements for highbush blueberry.

tion with the 15 kPa requiring significantly more than the 20 kPa during the 1993 growing season. The slope of the curve indicates water demand per month and is directly related to plant size. All three treatments showed a steady increase in water demand over the three consecutive growing seasons. This is consistent with the trends in the growth patterns.

Fig. 5 shows the three cumulative irrigation amounts for the three highbush treatments. The 10 kPa treatment again required the most irrigation compared to the 15 and 20 kPa treatments. Through the 1991 and 1992 growing seasons, the 10 kPa treatment required about twice as much irrigation as the other two. Continuing into the 1993 growing season, there was a surge in irrigation demand by the 10 kPa treatment, four times the total of the 20 kPa and about two and one-half times that of the 15 kPa treatment. This is consistent with the growth patterns of the plants.

The difference between the 15 and 20 kPa treatments for highbush was more pronounced than for the rabbiteye. The 15 kPa treatment consistently required 50% to 75% more irrigation than the 20 kPa.

Comparing the two types of blueberries, it is clear that the rabbiteye demands more irrigation. There was a significant difference in water demand per treatment between the two types. The rabbiteye had a large difference in irrigation demand between the 10 and 15 kPa treatments but, the difference between the 15 and 20 kPa treatments was small. The highbush, however, had a significant difference between all three water treatments.

Growth. Fig. 6 shows plant volumes for all the three rabbiteye treatments. The 10 kPa treatment consistently maintained the largest size during all three seasons. This is consistent with the increased water demand. The 15 and 20 kPa treatments were similar in size and slightly smaller

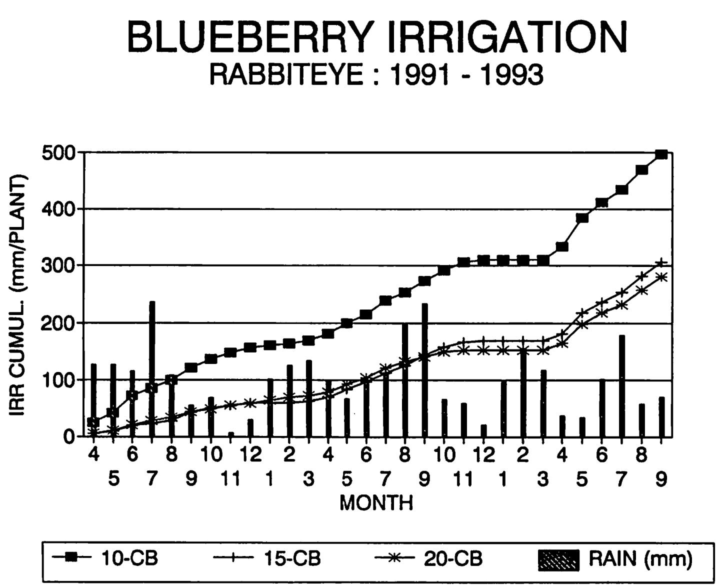

Figure 4. Irrigation requirements for rabbiteye blueberry.

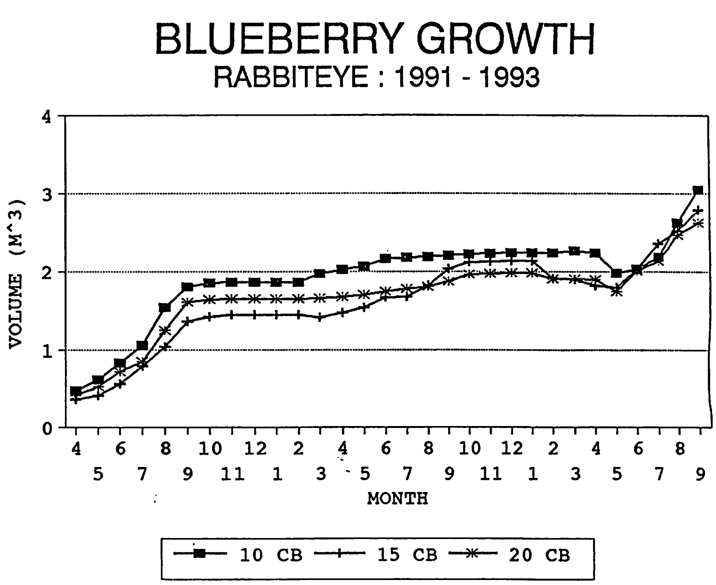

Figure 6. Growth patterns for rabbiteye blueberry.

than the 10 kPa. However, the 20 kPa treatment displayed the slightly lower growth rate and size which is consistent with the irrigation patterns discussed previously. The survival rate for all rabbiteye treatments was 100%.

Fig. 7 shows plant volumes for all three highbush treatments. The 10 kPa treatment maintained the largest size and growth rate of the three treatments. During the 1993 growing season, this treatment experienced a surge in growth which is consistent with its high irrigation demand in 1993. The 15 and 20 kPa treatments maintained a slow, yet steady growth pattern. The 15 kPa treatment maintained a healthy canopy with a slow growth rate while, the 20 kPa experienced erratic growth behavior, even death, due to excessive soil water stress. These growth patterns were consistent over the 3 years.

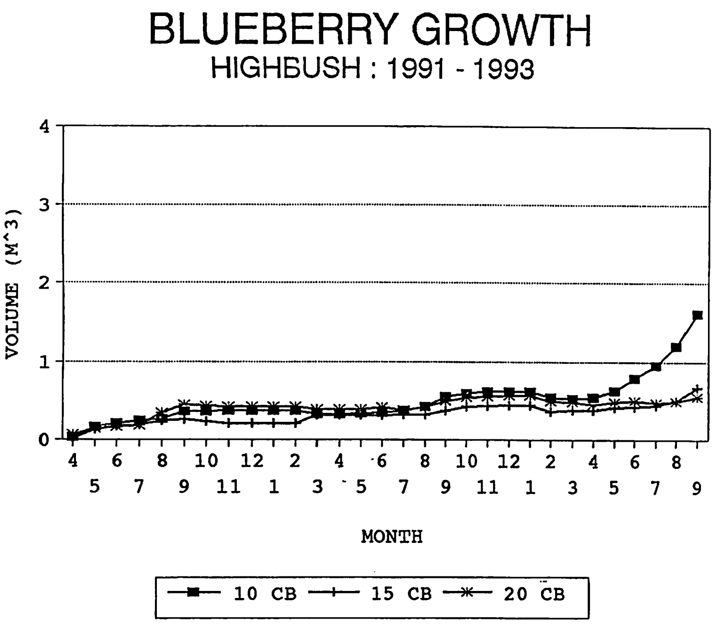

Figure 7. Growth patterns for highbush blueberry.

The rabbiteye appeared to establish itself quicker than the highbush with minor growth variations associated with water stress. In contrast, highbush establishment was slower with very significant variations associated with water stress. The 20 kPa treatments revealed a pronounced difference between the two types. The rabbiteye 20 kPa exhibited normal growth patterns while, the highbush 20 kPa exhibited erratic to severely reduced growth patterns due to this stress level.

Conclusions

Two blueberry types, rabbiteye and highbush, exhibited very different patterns of growth and irrigation demand. The rabbiteye is recognized by its vigorous growth, flexibility with respect to water stress, and high yield. The highbush is recognized by its slower growth, water stress sensitivity, and early berry ripening characteristics. For both types, the higher rates of water application produced a faster growing and healthier plant. The relationship between growth and water stress is clearly defined for the highbush variety but, it is less pronounced for the rabbiteye.

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