rupted growth during fullbloom, as in the first experiment, also resulted in seed with the lowest ABA content.

The sensitivity of 'Earliwax' snapbean plants to enhancement of endogenous seed ABA content during high temperature stress appears to depend on intensity of stress and growth stage of the plant when stress occurs. A longer photoperiod tends to increase seed ABA content even in the absence of temperature stress. Others (2, 3, 4) have shown environment and stress can have significant effects on endogenous ABA levels in the vegetative tissue of bean plants.

The ABA content in seeds of 'Earliwax' plants subjected to high temperature pre-, during, or postanthesis, or grown under different photoperiods, showed smaller, but in some cases significant differences. These differences might affect subsequent germination and early seedling development (6).

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Daylength Effect on Root Development of Jicama (*Pachyrrhizus erosus* Urban)[1]

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Additional index words. photoperiodism, yam bean

Abstract. **Two jicama (*Pachyrrhizus erosus* Urban) or yam bean cultivars were grown for 0, 30, or 65 days of natural daylength prior to placement under short days (9-hour natural light, 0800 to 1700 hours) and long days (short day plus 87 watts/m^2 incandescent light, from 2200 to 0200 hours). After 10 weeks, fleshy root growth was more rapid and extensive under short days for both cultivars in all pretreatment exposures. After 20 weeks, the relative differences in root dry weight were greater for 0- and 30-day pretreatment and in 'Cristalina' than in 'Agua Dulce'.**

Jicama, a tropical legume with a pubescent vine growth habit (3), has been cultivated in Mexico since the time of the Aztecs (2). The edible light brown fleshy root weighs 0.5 to 2 kg. The nutritional value of its crispy, white flesh is low (6). It contains 10% to 15% dry matter and about 1% protein, and is rich in K, P, Ca, and ascorbic acid (1). Roots are imported from the states of Guanajuato, Michoacan and Morelos, Mexico (4).

In a 1976 field planting, jicama foliage grew extensively until frost. Flowering began in mid-September – short days are required to initiate flowering (9), but the elongated (5-8 cm) storage root swelled only slightly (1.0 cm).

Winter grown greenhouse plants had relatively large fleshy roots and small tops suggesting that root development required short days. This observation agrees with one made in Hawaii (5), but no data have been published. Our report summarizes research conducted to determine daylength effects on root growth.

Seeds of 'Cristalina' and 'Agua Dulce' jicama (4) were planted in 15 cm diameter pots on July 12, 1977, and emerged seedlings were divided into 4 and 2 uniform replicates, respectively on July 26.

One-third of each group was put in the photoperiod treatments on the same day, half being transferred to the short-day treatment (black curtain was drawn at 1700 and removed at 0800 hr) and the other half to the long-day treatment (short-day treatment plus 87 watts/m^2 incandescent lamp from 2200 to 0200 hr). Another one-third of the plants were grown in natural daylight for 30 days (until August 25), and the remaining one-third for 65 days (until September 29), before being put in the short-day or long-day treatments. Natural daylight ranged from 13.9 hr on July 26, when pretreatments started, to 11.95 hr on September 29, when the longest pretreatment ended.

Plants were grown for 10 weeks or 20 weeks after daylength treatments began. At termination, the medium was carefully washed from plant roots and the top was severed from the root at the soil level. The fibrous roots were separated from the fleshy storage portion. Each plant part was oven-dried at 65°C for 5 days and weighed.

Fleshy root development of plants with 0, 30 or 65 days pretreatment was stimulated under short days during the first 10 weeks of growth for both cultivars (Table 1). After 20 weeks, the weight of 'Cristalina' plant roots under short days was about double that under long days, for plants that had the 0- and 30- day pretreatments. Root growth of 'Agua Dulce' was relatively high after 20 weeks under long days.

Top growth was more extensive on plants under long days. On plants under short days, apical buds, and then axillary buds, turned yellow and ultimately died. This behaior is consistent with that reported for other plants (8). As a result, the plants under short-day treatment were short, compact, and bushy, and the tops did not grow substantially in the second 10 weeks. No plants flowered during the test.

The results indicate that short days are necessary to initiate and/or stimulate fleshy jicama root development. Leopold and Kriedemann (7) concluded that the photoperiod control or influence on tuber or bulb formation embraces all the classical facets of photoperiods as worked out for the control of flowering.

Production of commercially acceptable roots in the Southwest is not yet feasible. However, induction of fleshy roots in greenhouse-grown transplants under short days may be a satisfactory pretreatment. Fleshy root seemed to be

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Table 1. Dry weight of fleshy root of 2 cultivars of jicama grown under daylength of 9 hr (SD) and 9 hr + 4 hr night interruption (LD) for 10 and 20 weeks.

Natural daylength pretreatment (days)	Time (weeks)	Daylength	Fleshy root dry wt (g/root) 'Cristalina'	Fleshy root dry wt (g/root) 'Agua Dulce'
0	10	SD	1.74	2.33
		LD	0.39**	0.61^{NS}
	20	SD	9.63	7.99
		LD	4.20^{NS}	5.62^{NS}
30	10	SD	4.15	6.00
		LD	1.32**	1.99**
	20	SD	13.40	10.21
		LD	7.68*	11.15^{NS}
65	10	SD	11.37	8.08
		LD	1.63**	5.12*
	20	SD	10.55	14.74
		LD	8.70^{NS}	8.41^{NS}

*, **, ^{NS}Significance between daylengths within cultivar significant at 5% level (*), 1% level (**), or nonsignificant (NS).

initiated after 65 days of greenhouse pretreatment, (where plants received 2 to 3 weeks of about 12-hr days) and development continued under long days.

After 20 weeks, growth of 'Agua Dulce' roots was not significantly different under short or long days. Also, variation in the fleshy root development was found to be relatively high. Both suggest that sufficient variability exists within cultivars, particularly 'Agua Dulce', to enable selection of intermediate or long-day plant types.

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Early Effects of Viruses on the Growth and Productivity of Asparagus Plants[1]

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Additional index words. Asparagus officinalis

Abstract. Asparagus officinalis **L. plants infected with either asparagus virus 1 or asparagus virus 2 exhibited mild reduction of vigor and productivity. Plants infected with both viruses showed severe decline and mortality in the second year in the field.**

Several viruses have been reported to infect asparagus plants in commercial fields in both Europe and North America (1, 2, 4, 5, 6, 7, 10). Weissenfels and Schmelzer (10) first reported that virus infections caused asparagus plants to lose vigor and productivity, with yield being reduced by at least 20%.

In Europe, asparagus virus AV-1 and AV-2 are quite common and can be easily detected in older commercial fields by virus-indexing procedures (2, 5, 10). In Washington, Mink and Uyeda (4) isolated 2 viruses from asparagus fields, B-type and C-type, which they considered to be isolates of AV-1 and AV-2, respectively.

The effects of the Washington isolates of AV-1 and AV-2 on asparagus plant development under field conditions were studied. Asparagus seedlings exhibit considerable variation in growth habit, productivity, and disease resistance. Therefore, a single clonal population of plants was developed by tissue culture, using 4 ten-year-old asparagus plants which had been originally propagated by tissue culture from a single pistillate selection. These 4 source plants were indexed for viruses and found to contain either AV-1 alone, or AV-1 + AV-2 (4). However, these plants showed no symptoms under field conditions.

Plantlets, obtained by tissue culturing stem tips and apical meristems from the 4 source plants, were indexed for viruses by the virus-indexing procedure of Mink and Uyeda (3, 4, 8) and were separated into 4 groups: 1) virus-free, 2) AV-1 infected, 3) AV-2 infected, and 4) AV-1 + AV-2 infected. The plantlets were grown in pots containing a soil mixture for 6 to 8 months in a greenhouse. During this period, no difference was observed between virus-free and virus-infected plants (9). The plants were transferred into the field on June 6, 1977, when they were about 70 cm tall and had 3 to 4 shoots. The planting was not replicated.

At the end of the 1977 growing season no difference in growth habit and appearance was observed between virus-free and virus-infected plants. Most of the plants started to produce new shoots by the middle of April, 1978, regardless of their virus status. However, a few did not produce shoots and died by the end of May. By the end of July, short, yellowish, less vigorous stems were observed on some of the AV-1 + AV-2 infected plants.

The effects of viruses on plant survival and appearance after 16 months in the field are presented in Table 1 and Fig. 1. The group infected with both viruses had the lowest survival (57%). This group also produced the lowest plant height, the fewest shoots, the smallest fresh and dry weights, and were obviously much less vigorous than the virus-free group. The groups infected with AV-1 or AV-2 alone were somewhat shorter, had fewer shoots, lower fresh and dry weights, and were less vigorous than the virus-free group.

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