

Table 6. Effect of variation in osmotic concentration and GA 4/7 (100 ppm) in the priming solution on emergence of pepper seeds at 15°C in the growth chamber.

Osmotic concn. (bars PEG)	GA 4/7	Duration (days)	Emergence		MDE ^z
			Total (%)	Abnormal (%)	
Distilled water -4	—	—	80a ^z	0b	20.1a
	—	3	83a	2.7ab	17.6bc
	+	3	77a	5.3ab	18.0b
	—	4	77a	2.7ab	15.8cde
	+	4	80a	12.0a	16.9bcd
-6	—	4	75a	2.7ab	15.2de
	+	4	77a	5.3ab	15.7cde
	—	5	76a	6.7ab	16.0cde
	+	5	77a	2.7ab	14.9e

^zMDE = mean days to emergence.

^yMean separation in columns by Duncan's multiple range test, 5% level.

tion did not improve emergence rate over the treatments without GA. Priming durations of 4 or 5 days were similarly effective. Again, priming at -6 bars PEG and 100 ppm GA 4/7 for 5 days reduced the MDG by 5.2 days compared with nontreated seeds. Total germination was unaffected by priming.

Although seed soaks in NaOCl may aid as a seed disinfectant they may reduce germination rate if the seeds are soaked for extended periods or if high concentrations of

NaOCl are used. However, pepper seeds could be successfully primed and redried to improve germination rate under optimum and stressful conditions. In order to control germination during the priming process it is essential to use an osmoticum. A 4 or 5-day duration was sufficient to decrease MDG without adversely affecting normal seedling development. The use of GA 4/7 improved germination rates slightly but was not absolutely necessary for the optimum benefits of priming.

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BACTERIAL LEAF SPOT DISEASES ON TOMATOES IN FLORIDA AND THE CONTROL OF TWO SUCH DISEASES WITH BACTERICIDES¹

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Abstract. There are a number of bacterial foliar diseases associated with tomatoes (*Lycopersicon esculentum* Mill.) in Florida, with bacterial leaf spot caused by *Xanthomonas campestris* pv. *vesicatoria* (Doidge) Dye (XCV) being the predominant disease. Recently, outbreaks of bacterial speck (*Pseudomonas syringae* (Okabe) Dye pv. *tomato*) have become more numerous. In the winter-spring 1983 growing season, tomato crops in southwestern Florida experienced an outbreak of bacterial speck and a new leaf spot incited by *Pseudomonas viridiflava* (Burkholder) Dowson (PV). Symptoms induced by PST and PV, although not identical, may be confused with XCV or with gray leafspot, incited by *Sternophyllum solani* Weber or with early blight incited by *Alternaria solani* (Ell. & G. Martin) Sor. Leafspots caused by XCV and PV were significantly reduced in experimental plots

sprayed with copper or copper + mancozeb compounds early in the spring of 1983.

Generally, bacterial leafspot diseases in southwest Florida are unimportant in spring crops because it typically is dry that time of year. However, the spring of 1983 was an unusually wet growing season and was conducive for bacterial development. Several fields were affected by what initially was thought to be bacterial leafspot in February and March. Upon isolation, 2 separate organisms were obtained. They were *Pseudomonas viridiflava* (PV) and *P. syringae* pv. *tomato* (PST). In one of the fields where only PV was isolated, once the rains subsided, the disease also remitted. But in fields where PST was isolated, the disease continued to develop, although slowly, even after the rains subsided.

Bacterial leafspots associated with tomato have primarily been incited by PST, the causal organism of bacterial speck (10), and *Xanthomonas campestris* pv. *vesicatoria* (XCV), the incitant of bacterial spot. In Florida, bacterial spot is, without question, the most prominent and destructive bacterial disease. Recently, bacterial leafspots incited by *P. syringae* pv. *syringae* (van Hall) Young, Dye and Wilkie (PSS) and PV (J. B. Jones, unpublished data) (6, 8, 12) have been quite destructive in tomato production areas and/or tomato transplant fields.

The purpose of this study is to present information on the bactericidal control of PV-induced leafspot and XCV-

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induced bacterial leafspot. Also, we will compare the 4 leafspots in order to provide a better understanding for discerning between them in the field.

Materials and Methods

'Sunny' tomato transplants were set in the field on March 10, 1983 into raised black plastic mulch covered beds. The experimental plot consisted of a randomized complete block design of 15 treatments with 4 replications per treatment. Each plot contained 15 plants that were spaced 12 inches apart. Spray applications were first applied March 17 and at weekly intervals thereafter through June 16, 1983, using a CO₂ sprayer. *Bacillus thuringiensis* (Berliner) var. *israelensis* or methomyl was used as required for control of lepidopterous larvae. Chemicals tested were: mancozeb 80WP (Dithane® M-45); chlorothalonil (Bravo® 500, 42 lb./gal); tribasic copper sulfate (Cities Service Co., 53% metallic copper); AR 153844 (8% metallic copper liquid); COCS (copper oxychloride sulfate WP and WDG); hexachlorophene (Nabac® 25EC); NA-hexachlorophene (Isobac® 20, monosodium salt of hexachlorophene); MRD Zn 350 (4% metallic copper and 4% metallic zinc); MRD Zn 300 (8% metallic zinc); CS 81-2 (50% metallic copper); and Komix® and K-maneb®, which are copper-maneb products.

Ten terminal leaflets were sampled from each plot on 4 separate dates throughout the experiment. Bacterial induced lesions were counted on each leaflet. All ripe and mature green fruit were harvested from plots on June 9, June 24 and July 7, 1983.

Results and Discussion

Symptomatology. Bacterial spot and bacterial speck attack all above ground portions of the plant (2, 5). Stem, petiole and rachis infections are commonly observed with both diseases and basically it is difficult to discern the causal organism based on symptoms. Fruit symptoms generally are quite different between the 2 diseases with spot causing scab-like lesions 0.04-0.31 inches in diameter that are brown to black and slightly raised, whereas bacterial speck is typified by very small dark brown pustules (rarely greater than 0.04 inch in diameter) which are slightly raised.

The bacterial leafspots incited by PV and PSS can easily be confused with PST and XCV. Leaf spots are quite large and often do not contain prominent halos. PV and PSS, unlike PST and XCV, require wounding or excessively

high moisture for infection and resulting disease development.

Identification of the bacterial leafspots on tomato by symptomatology is difficult. Distinguishing between these 4 leafspots and at least 2 leafspot diseases incited by fungal pathogens based on symptoms is improbable and isolation is essential to lessen the uncertainty. A fair judgment may be made as to the causal agent if weather conditions are considered while making the diagnosis. XCV is considered a warm weather pathogen, causing extensive damage at 75-82°F (1, 9), whereas PST is a cool weather pathogen (11) that causes extensive damage at 65-77°F. Thus, XCV was an unlikely suspect during the spring of 1983 and PST was the probable cause of the prevailing disease. The presence of the other fluorescent bacteria (PV and PSS) on tomatoes (both of which appear to be cool weather pathogens), makes the diagnosis more difficult during the cooler months of the year. An epiphytotic during the warm summer months can probably be attributed to XCV, whereas one during the cool periods can most probably be attributed to PST, PV or PSS, although on occasion, bacterial spot may be involved.

Control. Both XCV and PV were isolated from tomato lesions in the experimental plots. Leaf spot severity was highest early in the season (Table 1). Later in the season, as precipitation became more sporadic, disease levels declined. In the first ratings the copper treatments with mancozeb + COCS-WDG + Polyram, and the high rates of NA-hexachlorophene and hexachlorophene resulted in significantly fewer bacterial leafspots compared to the control which received weekly applications of chlorothalonil. In the second rating, all treatments significantly reduced disease compared to the control. All copper treatments (except K-Maneb and MRD Zn 350) and the high rates of NA-hexachlorophene and hexachlorophene reduced leaf spotting significantly in the third observation. On May 27, 1983, all treatments with the exception of NA-hexachlorophene at the low rate, reduced disease significantly. An average of the 4 ratings was determined which indicated all treatments except K-Maneb, MRD Zn 300 + mancozeb, and hexachlorophene and NA-hexachlorophene at the low rates, reduced disease severity compared to the control. Reduction in disease severity did not result in yield increases (Table 1). One treatment significantly reduced yields.

Coppers in combination with maneb or alone have effectively reduced bacterial spot (4) and bacterial speck (3). In this test all of the coppers, used alone or in combination

Table 1. Control of *Pseudomonas viridiflava* leaf spot and bacterial leaf spot on 'Sunny' tomato with bactericides.

Treatment and rate (lb./100 gal)	<i>Pseudomonas viridiflava</i> and bacterial spot rating (1983)				Avg rating	Marketable fruit (tons/acre)
	April 13	April 28	May 12	May 27		
CS 81-2 (3) + mancozeb (1.5)	52.50 ^{vdex}	49.3 cd	15.0 c	28.0 bc	36.2 de	56.14 bc
Tribasic copper sulfate (3) + mancozeb (1.5)	34.25 e	19.0 cd	23.0 c	13.5 c	22.5 e	69.21 a
MRD Zn 300 (2 ^z) + mancozeb (1.5)	261.75 a	67.3 bc	31.5 bc	40.5 bc	100.3 abc	62.44 abc
MRD Zn 350 (2 ^z) + mancozeb (1.5)	166.00 abcde	28.3 cd	29.5 bc	15.0 c	59.7 bcde	64.37 abc
COCS WDG (2) + Polyram (1.5)	42.00 e	29.5 cd	20.8 c	21.3 c	28.4 e	67.80 ab
COCS WP (2) + Polyram (1.5)	56.25 cde	41.0 cd	16.0 c	29.8 bc	35.8 de	56.14 bc
Hexachlorophene (0.25 ^z)	118.50 bcde	119.3 b	170.3 a	28.5 bc	109.2 ab	53.24 c
Hexachlorophene (1.5 ^z)	21.25 e	4.3 d	30.0 bc	26.3 bc	20.5 e	39.69 d
NA-hexachlorophene (0.25 ^z)	169.75 abc	108.5 b	176.3 a	79.8 ab	133.6 a	56.14 bc
NA-hexachlorophene (1.5 ^z)	25.25 e	41.3 cd	35.8 bc	42.3 bc	36.2 de	47.92 cd
K-maneb (1.5 ^z)	177.25 ab	66.3 bc	92.0 b	37.0 bc	93.2 abcd	57.60 abc
Komix (2 ^z)	91.50 bcde	61.0 bcd	39.8 bc	42.0 bc	48.6 bcde	63.89 abc
AR 153844 (2.0 ^z)	54.75 cde	62.0 bcd	23.5 c	31.0 bc	42.8 cde	61.95 abc
AR 153844 (2.0 ^z) + mancozeb (1.5)	34.25 e	22.3 cd	13.5 c	14.8 c	21.2 e	65.34 ab
Control (chlorothalonil 1.5 ^z)	170.00 abc	182.8 a	63.5 b	100.3 a	129.2 a	62.44 abc

^zRepresents a liquid formulation.

^vNumbers represent the average number of spots on 10 leaflets/plot.

^aMean separation within columns by Duncan's multiple range test, 5% level.

with maneb, significantly reduced bacterial spot and the *P. viridiflava*-induced leafspot (average rating—Table 1). All compounds tested, with the exception of one, did not significantly affect yields in contrast with an earlier report (7).

PV leafspot appears to be a stress induced leafspot. Excessive moisture and/or injury is required for infection and disease to occur. Once the frequent rains and high winds subsided, no further damage occurred in fields where only PV was isolated. However, in fields where bacterial speck was present, considerable damage continued to develop, even after the weather conditions improved. Thus, for disease control, it is important to discern between PV and PST in terms of chemical control. With PV, once weather conditions improved, chemical control would be less of a factor whereas with PST there would be more concern to continue spray applications.

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GROWTH AND DEVELOPMENT STUDIES OF THE TOMATO¹

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Abstract. An assessment of the plant growth-yield relationship of tomato (*Lycopersicon esculentum* Mill. cv. Duke) under commercial production conditions was conducted during 1981-83. A more intensive study of the growth and development of the Duke cultivar was made at the AREC-Bradenton during 1983. Nine measures of vegetative growth and records of 10 fruiting characteristics were made. The following activity peaks in weeks from date of transplanting were stem diameter (12), number and area of leaves (10), weight of plant (11), number of branches (10), axillary breaks (10), number of flower clusters (12), and number of open flowers (11). Root mass increased slowly until week 8 after which time rapid development was noted. Fruit load peaks occurred at weeks 12 and 15 from planting. The data are presented in the family-of-curves format based on regression modeling. This data base should be of value in future crop loss determinations, yield potential studies and cultivar efficiency comparisons.

Comprehensive stage of growth studies on vegetables can serve many useful purposes. Such information can be used to determine loss levels due to pests, chemical toxicities, environmental stresses or mechanical damage (1, 4, 5, 9, 12). Stage of growth data also contributes to a greater understanding of crop response to cultural systems, comparisons of cultivar performance and assessment of yield potential (3,

6, 10, 11). The data could contribute to a greater understanding of crop growth and to crop modelling concepts, an area of increasing interest to plant scientists, water scientists, and engineers (10). Such information is vital to the development of reliable prediction of harvest date and yield estimates (2, 7). If these studies are implemented on commercial vegetable farms as well as at research centers, useful information can be gained in the characterization of the vegetable industry.

Comprehensive studies on the growth and development of recently released tomato cultivars in the full bed mulch system have not been given much attention in the past decade. This study was initiated in 1978 with 4 cultivars on commercial farms. This report covers only the performance of the 'Duke' tomato on commercial farms 1978-83 and the comprehensive growth stage conducted at the AREC-Bradenton in 1983.

Materials and Methods

Industry studies. Growth and fruit production data have been accumulated for the 'Duke' tomato on 7 commercial farms during the spring in crop years 1978, 1981, 1982 and 1983. All crops were grown with the full bed mulch system, seep irrigated and staked. Fields were selected which fell within a 10-day transplanting period and all fields were harvested within 105 days from setting. Containerized seedlings were used in all fields as were broad spectrum fumigants. All fruit were picked by IFAS workers, ring sized, and graded. At each sampling date, 7 plants at random were severed at the ground line, all fruit removed, plants weighed and stem diameter recorded 1 day before the commercial harvest began. The range of differences encountered in specific cultural inputs is presented in Table 1.

Controlled study. A comprehensive stage of growth study, utilizing the family of curves concept, was conducted on the 'Duke' tomato at the AREC-Bradenton March 18 to June 24, 1983.

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