Ornamental Section

OBSERVATIONS ON CULTIVARS OF COMMERCIAL CHRYSANTHEMUMS TO ASCOCHYTA BLIGHT, RUST AND THREE PETAL SPOT DISEASES

ARTHUR W. ENGELHARD

Gulf Coast Experiment Station
Bradenton

ABSTRACT

Fifty-two cultivars of commercial chrysanthemums were evaluated for susceptibility to Ascochyta blight (*Mycosphaerella ligulicola*), rust (*Puccinia chrysanthemi*) and a necrotic tissue reaction on blooms classified as tiny spot, large spot and necrotic petal tips. Differences among cultivars were observed for all five diseases.

INTRODUCTION

The wholesale value of Florida's commercial chrysanthemum (*Chrysanthemum morifolium* (Ramat.) Hemsl.) crop of cut flowers, potted plants and cuttings in 1968 was 18 million dollars (2). This crop was more valuable than any other herbaceous ornamental produced in Florida. Chrysanthemums are affected by several diseases and Ascochyta blight is one of the most serious (1).

The objective of this research was to determine the reaction of 52 cultivars to *Mycosphaerella ligulicola* Baker, Dimock and Davis (Ascochyta blight), *Puccinia chrysanthemi* Roze (rust) and flower petal reactions termed tiny spot, large spot and petal tip necrosis. Included among the 52 cultivars were spray, standard and pot cultivars, the majority of which are produced to some extent in Florida.

METHODS

Fifty-two cultivars of chrysanthemums were grown in ground beds 3.5 ft wide and 72 ft long under natural saran cloth. Rooted cuttings were set in an 8- by 6-inch grid spacing on February 10, 1969, lighted 4 hours at 10 ft-c for 17 nights, pinched on February 27, pruned to three stems on March 20 and either center or side buds removed on April 22. The plants were fertilized at the rate of 30 lb N and K/acre/week with NH_4NO_3 and KNO_3 watered over the plants and beds followed by overhead irrigation. Dry fertilizer, 6-6-6 30% organic plus trace elements, was incorporated at 500 lb/acre preplant and also placed between the plants after six weeks.

The fifty-two cultivars were planted in three beds in unreplicated plots of 28 plants each. An additional 3,052 plants ('Yellow Iceberg', 'Bright Golden Ann', 'Yellow Delaware') were grown in four adjacent beds to have a large plant population in the immediate proximity to encourage disease development. No fungicides were applied to the test plants and the four adjacent beds of extra plants were sprayed only when in bloom.

All of the plants were inoculated on March 6, 12 and April 2, 1969 with *Mycosphaerella ligulicola* (Ascochyta blight). The inoculum came from two sources: Petri plate cultures produced in the laboratory and conidia from naturally infected commercially grown plants.

The Petri plate cultures were grown on 1.5 per cent Difco potato dextrose agar and they were from 20 to 25 days old when used. Mycelial growth filled the plates. The mycelium and agar were macerated in distilled water in a Waring blender and filtered through a single layer of cheese cloth. Fifteen cultures in two gallons of distilled water were used on the first inoculation, 10 cultures in 1.5 gallons on the second inoculation and 13 cultures in 3 gallons on the third inoculation. This technique was known to provide infective inoculum.

Florida Agricultural Experiment Stations Journal Series No. 3377.

Thirty naturally infected chrysanthemum plants, seven inches tall, were received on March 6. They were held at room temperature in a polyethylene bag for three days and then dried at room temperature. Many pycnidia developed. When water was placed on pycnidia on a glass slide and observed with a compound microscope, conidia emerged. The conidia were harvested by placing the plants in distilled water for five minutes, then filtered through a single layer of cheese cloth. After harvesting the spores, the plants were dried again at room temperature. Conidia were used at the second and third inoculations. Two gallons of conidial suspension were applied at the second inoculation and on the third the conidia were combined with the inoculum (3 gallons) prepared from the Petri plate cultures.

The inoculum was applied with a knapsack sprayer by blowing the suspension across the beds at the bases of the plants. The inoculum was applied on each side of the beds. Inoculations were made in the late afternoon or evening and always in the rain. The plants stayed wet until the following day. Each suspension was tested on potted plants covered with polyethylene bags and incubated in the laboratory.

Rust (*Puccinia chrysanthemi* Roze) and flower reactions termed tiny spot, large spot and petal tip necrosis developed naturally.

The plants were rated for disease several times, depending on their stage of maturity, beginning on May 29, 1969.

The plants were rated for response to Ascochyta blight on a 0 to 10 basis as follows:

Rating	*Description*
0	No Ascochyta blight on plants.
2	Slight leaf infection near bases of plants. Very little spread from point of inoculation.
4	Leaf infection at bases of plants common with some infection up high on the plants.
6	Infection usually only on leaves. Many leaves infected from bottom to top of plant.
8	Lesions numerous on leaves, stems and buds. Plants not dying.
10	Severe infection of leaves, stems, peduncles and buds. Occasional plant dead or dying.

The odd numbers not shown indicate a disease reaction midway between the two adjacent numbers. The ratings do not include flower infection.

Insect control was maintained by spraying with Meta-Systox-R at 1.5 pt/100 gallons of water each Tuesday and with Guthion at 1.5 pt/100 each Friday during the vegetative growth period. Lannate 90WD at 0.25 lb/100 was applied each Tuesday and Friday when color began to show on the buds. Mites and insects were not a problem on the plants.

The cultivars were grouped in Tables 1, 2 and 3 according to classifications used in commercial catalogs as standard, spray and pot types. Some cultivars are listed under more than one category.

Results and Discussion

Ascochyta blight. (Table 1, 2, 3). Ascochyta blight developed slowly after the inoculations on March 6, 12 and April 2. The potted plants inoculated with each suspension of inoculum prepared for field inoculation and incubated in the laboratory always developed Ascochyta blight. In spite of the large number of chrysanthemum plants in the field, none of which received fungicides, it became obvious that Ascochyta blight was becoming severe on relatively few cultivars. By April 22, blight was well developed on the very susceptible cultivars 'Oregon', 'Mrs. Roy' and 'No. 2 Red Humdinger'. When disease ratings were started on May 29, some of the most

Table 1. Response of spray type chrysanthemum cultivars to five diseases

Cultivar	Foliage disease*		Flower spots*		
	Ascochyta	Rust	Tiny spot	Large spot	Petal tip necrosis
Starburst	4	1	4	0	6
Snow Crystal	2	0	6	4	6
#2 Shasta	2	0	1	0	0
Iceberg	3	2	4	0	1
Iceland	5	2	0	0	0
Pinocchio	3	0	0	0	0
Dolly	2	1	1	0	0
Bluechip	3	1	1	0	0
Portrait	4	0	1	0	0
Pink Marble	2	0	1	0	0
Telstar	5	0	4	0	0
Beauregard	4	2	0	0	0
Show Off	5	0	0	0	0
Giltglow	4	0	0	0	-
Inferno	4	2	0	0	0
Red Jetfire	3	0	0	0	0
#2 Red Humdinger	7	0	1	0	0
#2 Yellow Shasta	2	2	4	0	0
Yellow Shasta	2	0	1	0	0
Yellow Iceberg	3	2	1	0	0
Jubilee	2	2	0	0	-
Flamenco	2	2	10	0	1
Tangier	4	2	0	0	0

*Ascochyta blight and flower spots rated 0 = no disease and 10 = severe disease. Rust rated 0 to 2. See text for details.

Table 2. Response of standard type chrysanthemum cultivars to five diseases.

Cultivar	Foliage disease*		Flower spots*		
	Ascochyta	Rust	Tiny spot	Large spot	Petal tip necrosis
Iceberg	3	2	4	0	1
Albatross	8	2	4	0	1
Southern Comfort	2	2	10	10	10
Donlope's Wh. Spider	1	0	6	0	8
Imp. Ind. White	3	2	0	1	4
Starburst	4	1	4	0	6
Snow Crystal	2	0	6	4	6
Imp. Princess Anne	2	0	0	0	0
Lydia	4	1	0	0	0
Pink Champagne	3	2	4	0	0
Bunbu	1	2	8	0	6
Streamer	1	0	8	0	6
Dolly	2	1	1	0	0
#2 Red Humdinger	7	0	1	0	0
Mrs. Roy	9	1	0	0	0
Leo	2	0	1	0	0
Giltglow	4	0	0	0	-
Yellow Iceberg	3	2	1	0	0
Explorer	6	1	0	0	1
Sunray	2	0	0	0	0
Imp. Ind. Yellow	3	1	0	0	1
Luyona	2	2	4	0	1
Yellow Knight	2	0			
Bright Golden Anne	3	1	0	0	0
Flamenco	2	2	10	0	1

*Ascochyta blight and flower spots rated 0 = no disease and 10 = severe disease. Rust rated 0 to 2. See text for details.

susceptible plants were dead and/or dying while on the most resistant plants it was difficult to find a leaf with a single Ascochyta lesion. Disease development was uniform in the individual plots.

The cultivars 'Iceberg' and 'Yellow Iceberg' are produced in large volume in Florida and are used as a standard for comparing the other cultivars for resistance and susceptibility to Ascochyta blight. Both Icebergs received a rating of 3, which indicated a fairly high degree of resistance to Ascochyta blight. Lesions developed on the leaves on the lower third of the plants but very few up higher on the plants. The same reaction was recorded on the bed (763 plants) planted entirely to 'Yellow Iceberg'. Based on the amount of infection, the most desirable cultivars for Ascochyta blight resistance would be those rated 4 or lower. Plants rated 5 had too many upper leaves infected that reduced quality. The higher incidence of disease also increases the amount of inoculum in the field. Plants rated higher than five were damaged so much by Ascochyta blight they had no commercial value.

Table 3. Response of pot type chrysanthemum cultivars to five diseases.

Cultivar	Foliage disease*		Flower spots*		
	Ascochyta	Rust	Tiny spot	Large spot	Petal tip necrosis
Deep Snow Pink	4	0	6	1	1
Imp. Princess Anne	2	0	0	0	0
Pink Champagne	3	2	4	0	0
Deep Mermaid	3	1	8	1	1
Portrait	4	0	1	0	0
Deep Ridge	1	0	6	0	4
Royal Ridge	2	0	6	0	6
#2 Red Humdinger	7	0	1	0	0
Torch	2	0	0	0	0
Delaware	1	0	6	0	1
Bright Golden Anne	3	1	0	0	0
Yellow Delaware	1	0	6	0	0
Sunstar	2	0	0	0	0
Imp. Ind. Yellow	3	1	0	0	1
Yellow Mandalay	2	0	0	0	0
Starburst	4	1	4	0	6
Imp. Ind. White	3	2	0	1	4
Oregon	10	0	8	8	6
Neptune	4	1	8	0	6
Snow Ridge	2	0	6	0	0

*Ascochyta blight and flower spots rated 0 = no disease and 10 = severe disease. Rust rated 0 to 2. See text for details.

Spray Types (Table 1). Among the 23 cultivars on which the disease did not spread much beyond the point of inoculation (rated no higher than 2) were 'Snow Crystal', 'No. 2 Shasta', 'Dolly', 'Pink Marble', 'No. 2 Yellow Shasta', 'Yellow Shasta', 'Flamenco' and 'Jubilee'.

'No. 2 Red Humdinger', rated 7, had the highest rating with disease lesions on almost all of the leaves; a few stem lesions were also present. 'Iceland', 'Telstar' and 'Show Off' each were rated 5.

Standard Types (Table 2). Among the 25 cultivars that received a rating of 2 or less were 'Southern Comfort', 'Donlope's White Spider', 'Snow Crystal', 'Improved Princess Anne', 'Bunbu', 'Streamer', 'Dolly', 'Leo', 'Sunray', 'Luyona', 'Yellow Knight' and 'Flamenco'.

Cultivars with a high rating were 'Mrs. Roy' rated 9 with very severe disease followed by 'Albatross' rated 8, 'No. 2 Red Humdinger' rated 7 and 'Explorer' rated 6.

Pot Types (Table 3). Among the 20 cultivars that received a disease rating of 2 or less were 'Improved Princess Anne', 'Deep Ridge', 'Royal Ridge', 'Torch', 'Delaware', 'Yellow Delaware', 'Sunstar', 'Yellow Mandalay' and 'Snow Ridge'.

Of all the cultivars evaluated for Ascochyta blight, 'Oregon' received the highest rating of 10. Leaves, stems, peduncles, buds and entire plants died. 'No. 2 Red Humdinger' was rated 7.

Rust. (Table 1, 2, 3). All the cultivars were rated for rust susceptibility. The host reaction was rated 0 = no reaction, 1 = a flecking reaction and 2=pustules with spores. The infection occurred naturally and was light. Sporulation developed on the spray type cultivars 'Iceberg', 'Iceland', 'Beauregard', 'Inferno', 'No. 2 Yellow Shasta', 'Yellow Iceberg', 'Jubilee', 'Flamenco' and 'Tangier'; on the standard type cultivars 'Iceberg', 'Albatross', 'Improved Indianapolis White', 'Pink Champagne', 'Bunbu', 'Yellow Iceberg', 'Luyona' and 'Flamenco'; and on the pot

cultivars 'Pink Champagne' and 'Improved Indianapolis White'. This disease is generally not a problem under Florida conditions.

Necrosis on petal tissue (Table 1, 2, 3). Necrosis on petal tissue was classified in three categories: tiny spot, large spot and tip necrosis. The tiny spots were small, reddish-brown, sometimes elongated areas about 1-2 mm in the longest dimension. They did not increase in size and were not always readily apparent unless one looked closely at the petals. They occurred from the time the buds first showed color to the time the petals were completely unfurled. The large spots had a diameter of 5 mm or larger, sometimes elongated or extending along the margins of petals, but generally not on the tips. *Alternaria* sp. sporulated abundantly on the large spots. The tip necrosis occurred on the tips of petals, usually on blooms with the petals completely unfurled. *Alternaria* sp. sporulated abundantly on the necrotic tips. *Botrytis* was not isolated from the necrotic spots.

The etiology of the three types of necrotic responses on petals is being studied. These reactions were also observed in commercial fields.

Plant reactions to the necroses were rated 0 to 10. A 0 indicated no response. On the tiny spot reaction the 10 rating indicated several spots per petal, on the large spots a 10 rating indicated an average of one spot per petal and on the necrotic tips a 10 indicated necrotic tips occurred all around the outer periphery of the mature blooms. Tremendous variation occurred among the cultivars (Table 1, 2, 3).

The cultivar 'Southern Comfort' had all three of the necrotic reactions. The large spots first appeared when the buds were opening. The tiny spots appeared at a later stage of flower development and the tip necrosis developed when the blooms were almost mature (petals unfurled).

Other cultivars that had a high susceptibility rating to one or more of the necrotic tissue reactions were 'Starburst', 'Snow Crystal', 'Flamenco', 'Donlope's White Spider', 'Bunbu', 'Streamer', 'Deep Snow Pink', 'Deep Mermaid', 'Deep Ridge', 'Royal Ridge', 'Delaware', 'Yellow Delaware' and 'Snow Ridge'. The spider type chrysanthemums ('Donlope's White Spider', 'Bunbu', 'Streamer' and to a lesser extent 'Luyona') commonly had necrotic tissue at the tips of the long petals. The reaction was different from the "sunburn" reaction which supposedly occurs in the center area of the blooms when the hot sun shines on water held on the blooms.

Disease resistance or susceptibility is one of a number of critera the commercial flower producer should use to decide what cultivars to grow. As there are fungicides that will control many diseases on the foliage and blooms, growers often disregard disease resistance or susceptibility when selecting cultivars to grow. The result is that the grower may have a high population of susceptible plants at a time that coincides with an abundance of inoculum, weather conducive to disease development and poor or no spray coverage on the plants. The result is serious losses occur. The use of disease resistant cultivars would reduce such losses. The cultivars 'Oregon', 'Mrs. Roy', 'Albatross', 'No. 2 Red Humdinger' and perhaps 'Explorer' (rated 6) are very susceptible to Ascochyta blight. Planting them increases the risk of disease losses as well as being a source of inoculum for more resistant cultivars.

ACKNOWLEDGMENTS

The author expresses his appreciation to the Pan American Plant Company, West Chicago, Illinois, and Yoder Bros., Inc., Barberton, Ohio, for supplying many of the cultivars and to the R. J. Claprood Company, Sun City, Florida, for cultivars and for providing facilities for rooting cuttings.

REFERENCES

1. Jackson, C. R. and L. A. McFadden. 1966. Chrysanthemum diseases in Florida (Revised by R. O. Magie and A. J. Overman). Florida Agr. Exp. Sta. Bull. 637A. 49 p.
2. Waters, W. E. 1969. The ornamental horticulture industry of Florida and its implication to production in tropical Americas. Proc. Tropical Region ASHS 13: in press.