

EFFECT OF PREHARVEST FUNGICIDAL APPLICATION ON SOYBEAN SEED QUALITY UNDER HUMID TROPICAL CONDITIONS

V. ARULNANDHY

Regional Agricultural Research Centre, Maha Illuppallama

ABSTRACT

Five soybean (*Glycine max* (L.) Merr.) cultivars were sprayed with fungicides benomyl (Methyl 1—(butyl carbamoyl—2 benzimidazol carbamate), captan (N[(Trichloromethyl) thio]—4—cyclohexane 1, 2 dicarboximide), and a mixture of both at biweekly intervals from midflowering till maturity while the unsprayed plants served as control. Preharvest foliar application of fungicides significantly reduced field weathering of seeds, indicated by higher level of germination than unsprayed, in the cultivar F 73—14 which is highly susceptible to field weathering. The fungicidal application also increased the emergence rate, seedling length, and seedling dry weight significantly in this cultivar as well as in the others. Benomyl or captan spray significantly reduced the rate of deterioration of stored seeds and hence extended the half-life period of seeds stored under ambient humid tropical conditions by up to 60 days. The interaction of cultivar and fungicide in relation to seed quality was significant at the 5% level.

INTRODUCTION

Production of high quality soybean (*Glycine max* (L.) Merr.) seed and maintenance of viability and vigour of seed under storage in the humid tropics would be difficult. Seed-borne micro-organisms perhaps, are one of the major causes for poor quality seed in soybeans (Sinclair, 1982).

The studies of Ellis *et al.* (1976) and Paschal and Ellis (1978) implicated fungal pathogens in seed deterioration before harvest. The association of fungal species with soybean seeds has been reported from various parts of the world (Singh *et al.*, 1973; Chamberlain and Gray, 1974; Mengistu and

Sinclair, 1979; Franco Neto and Henning, 1980; Arulnandhy, 1983), including Sri Lanka (Premala Jeyanandarajah, 1983). The results of Ndimande *et al.* (1981) indicated that seed-borne fungi play an important role before harvest and minor role after harvest.

Ellis *et al.* (1976) demonstrated that foliar application of fungicides on soybean plants significantly reduced internally seed-borne fungi at maturity. Foliar application of fungicides was reported to have shown improvement on the germination of seed at harvest (Ellis *et al.*, 1976; Ndimande *et al.*, 1981).

The objective of this study was to determine the effect of preharvest foliar application of fungicides on soybean seed deterioration at two stages, prior to harvest and during storage, under humid tropical conditions prevailing in Sri Lanka. The conclusion derived from this preliminary study would perhaps, direct towards the improvement of seed quality in soybeans in the humid tropics.

MATERIALS AND METHODS

Five soybean cultivars were sprayed with fungicides benomyl (Methyl 1—(butyl carbamoyl)—2 benzimidazol carbamate), captan (N[(Trichloromethyl thio]—4—cyclohexane 1, 2 dicarboximide), and a mixture of both at 1:40 while the unsprayed plants served as control. The experiment was a factorial arranged in a randomized complete block design with 4 replications (Table 1).

According to the design of the experiment, the field plots were laid on 24 April 1984 at the Agricultural Research Station in Maha Illuppallama. Benomyl (Benlate 50% WP), captan (Captan 80% WP), and the mixture of both were sprayed at the prescribed rates to the corresponding plots at two week intervals from midflowering (development stage R2; Fehr *et al.*, 1971) upto harvest maturity (development stage R8). A total of 4 sprays were given.

Each plot consisted of 4 rows, each 5 m long and spaced 40 cm apart with a plant density of 20 plants per metre. Seeds were harvested from the centre 2 rows at maturity (development stage R8), dried well, and preserved under cold storage at 10°C and 45% relative humidity till the

FUNGICIDAL APPLICATION ON SOYBEAN SEED QUALITY

initiation of the storage experiment on 26 September 1984. All 80 samples were placed in paper bags and stored under ambient condition, characterized by typically mean maximum temperature of 32.6°C, mean minimum temperature of 23.5°C and mean relative humidity of 73.2%, for a period of 9 months. Germination tests were performed initially and at 3 month intervals.

Twenty-five seeds from each sample were drawn at random and planted in moist sterilized sand contained in plastic boxes for germination, under illumination for 8 hours a day using fluorescent lamps of 750—1000 lux and at a constant temperature of 30°C ± 1°C (approximate optimum for soybean germination; Delouche, 1952). Another 25 seeds of each sample were planted in the field with conditions favourable for germination; however, the soil temperature was variable for different germination tests (Table 2). Emerged seedlings were counted on 5 and 8 days after planting. Seedlings were carefully uprooted after 8 days of planting and classified in accordance with the criteria of the Association of Official Seed Analysts (1970). The seedling length and dry weight were determined, using 5 seedlings taken at random from each experimental unit. Seedling length was measured from the point of attachment of the cotyledons to the root tip. The same seedlings were used to determine the dry weight gravimetrically after drying at 60°C for 48 hours in an oven.

Germination percentage was used as a measure of seed viability. Reported germination values included only normal seedlings. Germination percentages were transformed to arcsine degree scale for the purpose of statistical analysis. The seedling length and dry weight were the measurements assigned to seed vigour, in addition to emergence rate which was computed as

$$\frac{1}{2} \left[\frac{\text{number of seedlings emerged after 5 days of planting}}{5} + \frac{\text{number of seedlings emerged after 8 days of planting}}{8} \right]$$

This is the modification of the method suggested by Maguire (1962). The data obtained on viability and vigour were subjected to the standard analysis of variance. Means were compared using Least Significant

Difference (Snedecor and Cochran, 1967). The storage half-life period was determined from the linear regression equations computed from the germination values during storage.

RESULTS AND DISCUSSION

Five soybean cultivars were sprayed with two fungicides to determine their effectiveness on the quality of seed at harvest and during storage. The results of this study indicated a considerable variation in seed quality characteristics (Tables 3—7). Seed lots produced under different treatments of fungicide X cultivar showed a range of 78.2 to 99.5% for sand germination and 76.9 to 97.5% for field germination (Tables 3 and 4). Preharvest foliar application of benomyl, captan and combination of both significantly improved subsequent germination in the cultivar F 73—14, but not in the others (Table 3). Field germination also indicated a higher level of germination in seeds that were produced, following the application of fungicides in the same cultivar but statistically insignificant (Table 4). While benomyl, captan and combination of both maintained higher germination of F 73—14 than untreated, the germination of the other cultivars remained high with and without the application of fungicides. It is clear that preharvest foliar application of fungicides slowed down the field weathering of seed in cultivars that are highly susceptible to field weathering under humid tropical conditions. Preharvest foliar application of fungicides benomyl, captan and combination of both significantly increased the emergence rate in cultivar F 73—14 (Table 5), seedling length in cultivar PM 78—13, and seedling dry weight in cultivars F 73—14 and Pb—1 (Table 7). The fungicides helped in reducing field weathering in some cultivars and not in the others. Thus, it is not surprising that the interaction between fungicide and cultivar was significant at the 5% level. The fact that foliar application of fungicides resulted in improved germination in soybean was also reported by Ellis *et al.* (1976) and Ndimande *et al.* (1981).

Preharvest foliar application of fungicides did not prevent subsequent deterioration of seed under ambient storage but retarded the rate of deterioration (Tables 3—7). For example, before storage the germination of promptly harvested Pb—1 was 99.5 and 98.2% from benomyl treated and untreated plants, respectively and 85.6 and 4.0% after 6 months of ambient storage. The difference in viability after 6 months of storage was statistically significant (Table 3). Similarly, the germination of captan treated

FUNGICIDAL APPLICATION ON SOYBEAN SEED QUALITY

plants in the same cultivar was 87.2% which was 83.2% higher than untreated after 6 months of storage. Benomyl treated and untreated plants in another cultivar PM 78—13 showed 72.5 and 28.2% germination, respectively after 6 months of storage. In contrast, before storage the germination of promptly harvested F 73—14 was 96.2 and 78.2% from benomyl treated and untreated plants and the germination dropped to 3.6% and zero, respectively after 6 months of storage (Table 3). Considering the field germination in cultivar PM 78—13, benomyl and captan respectively showed germination 49.8 and 27.7% higher than untreated after 6 months of storage. The differences were found statistically significant (Table 4). The half-life period of the seeds produced, after preharvest foliar application of fungicides, was calculated from the data on viability of stored seeds under ambient conditions (Figure 1). The seeds produced after the foliar application of either benomyl or captan had half-life period about 60 days longer than untreated in the cultivar Pb—1 and 25 days longer in F 73—14. However, the combination of both benomyl and captan failed to produce a better result than either of them applied separately.

Like seed viability, seed vigour expressed in terms of emergence rate, seedling length and seedling dry weight was relatively higher for the foliar application of fungicides than unsprayed (Tables 5, 6 and 7). After 6 months of storage, emergence rate, seedling length and seedling dry weight of seeds from plants sprayed with benomyl or captan were found significantly greater than untreated in most of the cultivars included in this experiment. It is evident that preharvest foliar application of appropriate fungicides can reduce field weathering of seeds and maintain better viability and vigour during storage as well. Therefore, there is a great possibility of increasing seed longevity by the application of appropriate fungicides before harvest but it is cultivar dependent. The data confirm the previous report that foliar fungicidal sprays before harvest reduces the deterioration of soybean seed in storage (Ndimende *et al.*, 1981). The preharvest fungicidal applications perhaps, prevent or reduce the invasion of fungi that could cause seed deterioration under humid tropical conditions. At earlier instance, Ellis *et al.* (1976) reported that seeds of soybean plants sprayed with fungicides had significantly less seed-borne fungi and higher germination than seeds from non-sprayed plants. It should be mentioned that in our investigation, no assessment was made on fungal association with seeds.

CONCLUSIONS

Apparently the foliar application of appropriate fungicides before harvest can reduce field weathering of seed and seed deterioration during storage and as a consequence of which the longevity of soybean seed stored under humid tropical conditions can be prolonged. Very likely, the effect of preharvest fungicidal application on the improvement of seed quality at harvest and longevity of stored seed is cultivar dependent. Preharvest foliar application of fungicides may be considered as a measure to produce high quality seed and reduce deterioration of seed during storage in the humid tropics; however, cost factor needs to be worked out before the recommendation is made. This management technology is more appropriate to cultivars producing low quality seeds and seeds of which deteriorate rapidly in storage under humid tropical conditions.

ACKNOWLEDGEMENTS

The author expresses his sincere appreciation to Prof. Y. D. A. Senanayake, Director, Postgraduate Institute of Agriculture, University of Peradeniya for the valuable guidance and encouragement during the course of this study and also in the preparation of this manuscript. He also wishes to acknowledge with gratitude the facilities provided by the Department of Agriculture to complete the study successfully.

REFERENCES

- Arulnandhy, V. (1983). Effect of seed-borne fungi on seed germination in soybeans. *Tropical Agriculturist* 139, 57 — 66.
- Association of Official Seed Analysts. (1970). Rules of testing seeds. *Proceedings of the Association of Official Seed Analysts* 60 1 — 116.
- Chamberlain, D. W. and E. E. Gray (1974). Germination, seed treatment, and micro-organisms in soybean seed produced in Illinois. *Plant Disease Reporter* 58, 50 — 54.
- Delouche, J. C. (1952). Influence of moisture and temperature levels on germination of corn, soybean, and water melon. *Proceedings of the Association of Official Seed Analysts* 43, 117 — 126.
- Ellis, M. A., S. R. Foor and J. B. Sinclair (1976). Effect of benomyl sprays in internally-borne fungi and germination of delay-harvested soybean seeds. *Phytopathology* Z. 85, 159 — 162.

FUNGICIDAL APPLICATION ON SOYBEAN SEED QUALITY

- Fehr, W. R., C. E. Caviness, D. T. Burmood and J. S. Pennington (1971). Stages of development description of soybean (*Glycine max* (L.) Merr). *Crop. Science* 11, 929 — 931.
- Franco Neto, J. de B. and A. A. Henning (1980). Problems in evaluating germination of seeds of soybean with high incidence of *Phomopsis sojae*. *Soybean Abstract* 4, 248.
- Maguire, J. O. (1962). Speed of germination aid in selection and evaluation for seedling emergence and vigor. *Crop Science* 2, 176 — 177.
- Mengistu, A. A. and J. B. Sinclair (1979). Seed-borne microorganisms of Ethiopian grown soybean and chickpea seeds. *Plant Disease Reporter* 63, 616 — 619.
- Ndimande, B. N., H. C. Wein and E. A. Kueneman (1981). Soybean seed deterioration in the tropics I. The role of physiological factors and fungal pathogens. *Field Crop Research* 4, 113 — 121.
- Paschal, E. H. and M. A. Ellis (1978). Variation in seed quality characteristics of tropically grown soybeans. *Crop Science* 18, 837 — 840.
- Premala Jeyanandarajah (1983). The variation of fungal infections in soybean seeds with time of harvest. p. 30. In Proceedings of Thirty-Ninth Annual Sessions of Sri Lanka Association for the Advancement of Science, Part I, December 1983. SLAAS Publication, Colombo, Sri Lanka.
- Sinclair, J. B. (1982). Seedborne microorganisms and viruses and seed quality. p. 42 — 45. In Seed quality and Stand Establishment (eds. J. B. Sinclair and J. A. Jacobs). INTSOY Series No. 22, University of Illinois, Urbana, Illinois.
- Singh, O. V., V. K. Agarwal and Y. L. Nene (1973). Seed health studies in soybeans raised in Nainital Tata, India. *Indian Phytopathology* 26, 260 — 267.
- Snedecor, G. W. and W. G. Cochran (1967). Statistical Methods, 6th Edition, The Iowa State University Press, Iowa, 593 p.

Table 1. Cultivars and fungicides included in the experiment.

<i>Cultivar (Factor 1)</i>	<i>Fungicide (Factor 2).</i>
1. PM 78 — 13	1. Benomyl (Benlate 50% WP at 60 g / ha)
2. PM 78 — 25	2. Captan (Captan 80% WP at 1.5 Kg / ha)
3. F 73 — 14	3. Benomyl and captan (same rate)
4. Bossier	4. No fungicide (control)
5. Pb — 1	

Table 2. Mean soil temperatures at a depth of 5cm during field germination and seedling emergence of stored seeds in germination tests.

<i>Stored period</i>	<i>Germination test no.</i>	<i>Soil temperature (°C)</i>
0	1	31.0 ± 1.1
3	2	30.4 ± 0.6
6	3	31.0 ± 1.2
9	4	24.7 ± 0.6

Table 3. Mean germination percentage (P) of preharvest-fungicide treated seeds in sand at 30°C initially and during storage under ambient conditions. Arcsine transformed values are in column A.

<i>Cultivar</i>	<i>Fungicide</i>	<i>Months in storage</i>							
		0		3		6		9	
		<i>P</i>	<i>A</i>	<i>P</i>	<i>A</i>	<i>P</i>	<i>A</i>	<i>P</i>	<i>A</i>
PM 78 — 25	Benomyl	95.1	77.2	98.9	84.1	59.1	50.2	0.0	4.1
	Captan	97.1	80.0	95.3	75.4	71.2	57.5	0.0	4.1
	Benomyl + Captan	90.7	72.2	98.9	84.1	39.9	39.1	0.0	4.1
	No fungicide	98.2	82.2	96.0	78.5	47.0	43.3	0.0	4.1
PM 78 — 13	Benomyl	97.5	81.0	98.9	84.1	72.5	58.4	0.0	4.1
	Captan	94.7	76.9	97.5	90.9	66.6	54.7	0.0	4.1
	Benomyl + Captan	94.1	76.0	96.4	79.1	40.9	39.8	0.0	4.1
	No fungicide	93.9	75.7	98.9	84.1	28.2	32.1	0.0	4.1
F 73 — 14	Benomyl	96.2	78.8	91.5	73.0	3.6	10.9	0.0	4.1
	Captan	97.3	81.0	92.6	74.2	0.0	4.1	0.0	4.1
	Benomyl + Captan	90.4	71.9	83.2	65.8	0.0	4.1	0.0	4.1
	No fungicide	78.2	62.3	71.7	57.9	0.0	4.1	0.0	4.1
Bossier	Benomyl	96.0	78.5	93.6	75.4	47.0	43.3	0.0	4.1
	Captan	94.7	76.7	96.2	77.7	39.9	39.3	0.0	4.1
	Benomyl + Captan	97.5	81.0	98.9	84.1	36.9	37.4	0.0	4.1
	No fungicide	95.1	77.2	98.5	82.7	27.2	32.5	0.0	4.1
Pb — 1	Benomyl	99.5	86.0	99.5	86.0	85.6	66.9	0.0	4.1
	Captan	98.2	82.2	98.9	84.1	87.2	69.0	0.0	4.1
	Benomyl + Captan	98.2	82.2	99.5	86.0	69.5	56.5	0.0	4.1
	No fungicide	98.2	88.2	98.0	81.9	4.0	11.5	0.0	4.1

L.S.D. (P=0.05) for fungicide
within cultivar

4.1

3.6

3.6

NS*

* Not significant

FUNGICIDAL APPLICATION ON SOYBEAN SEED QUALITY

Table 4. Mean germination percentage (P) of preharvest-fungicide treated seeds initially and after storage under ambient conditions in field test. Arcsine transformed values are given in column A.

Cultivar	Fungicide	Months in storage							
		0		3		6		9	
		P	A	P	A	P	A	P	A
PM 78—25	Benomyl	97.0	80.0	86.1	69.1	41.2	39.9	0.0	4.1
	Captan	94.2	76.1	85.3	67.5	37.5	37.8	0.0	4.1
	Benomyl + Captan	97.2	80.3	85.4	67.6	36.8	37.3	0.0	4.1
	No fungicide	97.2	80.3	85.4	67.6	36.8	37.3	0.0	4.1
PM 78—13	Benomyl	92.8	74.4	87.9	69.7	73.6	59.1	0.0	4.1
	Captan	93.8	75.6	90.7	72.3	51.5	43.8	0.0	4.1
	Benomyl + Captan	89.2	70.8	85.7	67.8	20.9	27.2	0.0	4.1
	No fungicide	85.2	67.4	80.1	63.5	23.8	29.2	0.0	4.1
F 73—14	Benomyl	89.9	71.5	85.0	67.3	19.2	26.0	0.0	4.1
	Captan	88.7	70.3	77.5	61.7	4.1	11.8	0.0	4.1
	Benomyl + Captan	97.5	81.0	79.6	63.7	5.1	13.1	0.0	4.1
	No fungicide	76.9	61.2	81.5	64.5	16.8	14.6	0.0	4.1
Bossier	Benomyl	93.8	75.6	82.3	65.2	18.9	25.8	0.0	4.1
	Captan	93.8	75.6	85.2	67.3	38.9	38.6	0.0	4.1
	Benomyl + Captan	87.8	69.6	78.4	62.3	24.0	29.4	0.0	4.1
	No fungicide	87.0	68.8	77.0	61.3	28.4	32.2	0.0	4.1
Pb—1	Benomyl	96.4	79.1	92.4	74.1	55.7	48.3	0.0	4.1
	Captan	94.9	76.9	80.8	64.0	46.0	42.7	0.0	4.1
	Benomyl + Captan	86.3	68.3	84.9	64.1	67.8	55.4	0.0	4.1
	No fungicide	89.0	70.0	74.6	59.7	37.7	37.9	0.0	4.1

L. S. D. (P=0.05) for fungicide
within cultivar

NS*

NS*

5.7

NS*

* Not significant

Table 5. Mean emergence rate of preharvest-fungicide treated seeds initially and during storage in sand and field germination tests (day⁻¹).

Cultivar	Fungicide	Sand germination test				Field germination test			
		Months in storage				Months in storage			
		0	3	6	9	0	3	6	9
PM 78 — 25	Benomyl	3.66	4.00	2.32	0.0	3.98	3.55	1.16	0.0
	Captan	3.73	3.63	2.17	0.0	3.83	3.60	1.07	0.0
	Benomyl + Captan	3.31	3.75	1.74	0.0	3.83	3.73	1.20	0.0
	No fungicide	3.68	3.65	1.24	0.0	3.99	3.15	0.65	0.0
PM 78 — 13	Benomyl	3.86	4.00	2.68	0.0	3.94	3.55	2.26	0.0
	Captan	3.76	3.90	1.98	0.0	3.72	3.23	2.03	0.0
	Benomyl + Captan	3.60	3.70	0.87	0.0	3.67	3.35	0.84	0.0
	No fungicide	3.70	4.00	1.48	0.0	3.61	3.23	0.63	0.0
F 73 — 14	Benomyl	3.60	3.65	0.24	0.0	3.47	3.48	0.25	0.0
	Captan	3.46	3.68	0.33	0.0	3.63	3.13	0.00	0.0
	Benomyl + Captan	3.47	3.33	0.00	0.0	3.74	3.30	0.37	0.0
	No fungicide	2.99	2.93	0.08	0.0	3.56	3.28	0.16	0.0
Bossier	Benomyl	3.86	3.88	2.19	0.0	3.62	3.43	0.73	0.0
	Captan	3.84	3.90	2.23	0.0	3.67	3.10	1.24	0.0
	Benomyl + Captan	3.84	3.98	1.90	0.0	3.36	3.33	1.01	0.0
	No fungicide	3.75	3.98	1.35	0.0	3.62	3.10	0.83	0.0
Pb — 1	Benomyl	3.99	4.00	3.03	0.0	3.83	3.70	1.77	0.0
	Captan	3.73	4.00	3.03	0.0	3.79	3.28	1.52	0.0
	Benomyl + Captan	3.91	4.00	1.73	0.0	3.69	3.95	2.50	0.0
	No fungicide	3.73	4.00	0.43	0.0	3.89	2.93	1.40	0.0
L. S. D. (P=0.05) for fungicide within cultivar		0.14	0.14	0.21	NS*	0.18	0.23	0.32	NS

* Not significant

FUNGICIDAL APPLICATION ON SOYBEAN SEED QUALITY

Table 6. Mean seedling length of preharvest-fungicide treated seeds in sand and field germination tests, after storage under ambient conditions (cm).

Cultivar	Fungicide	Sand germination test				Field germination test			
		Months in storage				Months in storage			
		0	3	6	9	0	3	6	9
PM 78—25	Benomyl	28.5	22.0	13.4	0.0	9.7	10.6	7.1	0.0
	Captan	29.4	20.5	7.6	0.0	11.6	13.2	10.0	0.0
	Benomyl + Captan	24.8	27.6	8.2	0.0	11.4	11.4	10.2	0.0
	No fungicide	27.7	17.3	4.9	0.0	11.9	11.7	6.2	0.0
PM 78—13	Benomyl	27.6	21.8	10.7	0.0	12.8	14.8	10.2	0.0
	Captan	34.4	21.6	9.1	0.0	13.5	13.0	10.8	0.0
	Benomyl + Captan	30.4	25.7	10.0	0.0	13.1	13.5	9.5	0.0
	No fungicide	20.7	23.5	4.4	0.0	12.0	13.0	8.5	0.0
F 73—14	Benomyl	17.3	18.3	0.7	0.0	12.3	14.4	3.2	0.0
	Captan	24.6	18.0	0.0	0.0	12.6	14.7	4.5	0.0
	Benomyl + Captan	26.9	13.9	0.0	0.0	13.1	14.1	0.0	0.0
	No fungicide	19.3	14.5	0.0	0.0	11.6	13.6	0.8	0.0
Bossier	Benomyl	37.3	22.4	6.4	0.0	10.4	13.9	8.2	0.0
	Captan	23.1	26.7	8.5	0.0	11.9	13.6	9.1	0.0
	Benomyl + Captan	28.6	21.3	6.9	0.0	13.1	13.2	6.1	0.0
	No fungicide	25.5	16.5	6.0	0.0	11.6	13.6	8.4	0.0
Pb—1	Benomyl	18.6	24.0	12.6	0.0	11.5	12.5	9.8	0.0
	Captan	28.7	19.7	10.2	0.0	12.8	13.0	10.1	0.0
	Benomyl + Captan	33.4	27.3	9.3	0.0	11.9	13.5	10.6	0.0
	No fungicide	32.1	14.4	1.4	0.0	12.8	12.9	9.3	0.0
L. S. D. (P=0.05) for fungicide									
with in cultivar		2.4	3.4	1.2	NS*	NS	NS	NS	NS
* Not significant									

Table 7. Mean seedling dry weight of preharvest-fungicide treated seeds in field and sand germination tests, after storage under ambient conditions (mg).

Cultivar	Fungicide	Sand germination test				Field germination test			
		Months in storage				Months in storage			
		0	3	6	9	0	3	6	9
PM 78 — 25	Benomyl	56.0*	64.1	101.8	0.0	99.0	94.0	71.1	0.0
	Captan	64.6	72.1	78.5	0.0	124.5	106.6	101.9	0.0
	Benomyl + Captan	64.8	72.4	78.7	0.0	94.8	103.5	127.5	0.0
	No fungicide	61.1	78.3	59.4	0.0	121.0	102.4	75.9	0.0
PM 78 — 13	Benomyl	94.1	80.9	106.1	0.0	160.8	160.5	141.3	0.0
	Captan	105.5	112.0	128.7	0.0	148.7	145.3	154.9	0.0
	Benomyl + Captan	112.1	122.9	116.9	0.0	161.5	141.5	107.2	0.0
	No fungicide	107.3	120.1	101.4	0.0	152.3	99.8	109.3	0.0
F 73 — 14	Benomyl	120.1	143.2	24.2	0.0	190.0	148.5	42.6	0.0
	Captan	117.2	149.8	0.0	0.0	207.7	118.9	74.4	0.0
	Benomyl + Captan	129.4	152.0	0.0	0.0	183.9	145.6	0.0	0.0
	No fungicide	108.1	130.7	0.0	0.0	227.7	133.7	16.1	0.0
Bossier	Benomyl	106.6	118.4	106.5	0.0	190.3	127.1	129.3	0.0
	Captan	135.3	190.0	128.7	0.0	157.3	155.9	141.3	0.0
	Benomyl + Captan	107.8	122.0	116.9	0.0	214.4	150.4	78.8	0.0
	No fungicide	120.9	133.1	101.4	0.0	203.0	137.5	121.5	0.0
Pb — 1	Benomyl	91.1	88.9	121.2	0.0	154.0	153.0	120.9	0.0
	Captan	128.3	112.3	115.5	0.0	140.6	106.6	129.9	0.0
	Benomyl + Captan	103.4	109.0	117.4	0.0	150.3	107.8	129.1	0.0
	No fungicide	88.9	98.8	14.9	0.0	157.4	104.8	138.6	0.0
L. S. D. (P=0.05) for fungicide within cultivar		8.4	10.4	7.8	NS*	NS	1.14	0.22	NS

* Values are in mg.

* Not significant