BIBLIOGRAPHY

SAPITAN, JOMERICK FIDEL. APRIL 2011. Screening of Celery Cultivars against septoria leafblight (*Septoria apiicola*). Benguet State University, La Trinidad, Benguet.

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ABSTRACT

The study was conducted at the Benguet State University and within the Plant Pathology Department experiment area from March to June 2010.The experiment aimed to determine the reaction of celery cultivars against septoria leafblight (*Septoria apiicola*).

Celery cultivars tested for leafblight resistance were all infected. However, Chinese celery had the lowest leafblight rating and the highest leafblight infection rating was from Tall Utah. Temperature range of 16.1 ^{o}C to 25.93 ^{o}C and high relative humidity of 84.25 % to 88% was conducive for leafblight formation. A rainfall of 13.58 mm - 29.73 mm allowed sporulation resulting to abundant spores. Chinese Celery exhibited the least leafblight infection while Amsa and Tall Utah 5270 were classified as moderately susceptible. Tall Utah was very susceptible.

TABLE OF CONTENTS

INTRODUCTION

Celery is native to the Mediterranean and adjacent areas. Its Latin generic name, *Apium*, is derived from the Celtic apon meaning "water", and refers to its habitat while *graveolens* means '"heavily scented". The stems of the wild plant are very bitter, thus distiguishing it from *var. dulce*, meaning sweet or pleasant.

Apiaceae is a plant family which yields two important vegetables known as Celery (*Apium graveolens*) and Celeriac. Cultivars of the species have been used for centuries, whilst others have been domesticated only in the last 200-300 years (Zohary and Hoft, 2000).

Celery is considered as a minor crop in the Philippines, celery is considered an important commercial crop grown around the world because it is utilize in homes and restaurants as appetizers, flavoring herb for broth, soups, dressing as well as excellent vegetable either stewed or creamed, and as salads It is also a good source of vitamin A, Ascorbic acid, and calcium and food energy (Thompson and Kelly, 1979).

In many parts of the country, vegetable constitute a large part of a diet. Some vegetables are salad crops suited for the climate of the province and one of them is celery.

There are no statistics on the production of celery in the Philippines. The only known areas producing the crop are Baguio, La Trinidad, Benguet and to some extent, and Davao.

Vegetable growing is number one industry and the main sources of income to majority of Benguet people. Due to the increasing demand for celery, Benguet farmers are engaged in celery production as a source of livelihood in rotation to other major vegetable crops. Despite the intensive production, many ordinary farmers experience low production in terms of good quality, and being safe from pesticides for consumption. Celery production during rainy season provides good income for farmers and can improve their standard of living. However, it is the condition where severe leaf blight infections often occur.

One way of increasing food production is proper selection of crops or crop varieties that are adapted in certain areas. The selection of varieties that have good qualities will not only benefit the farmer and the seed industry but also the country. Varietal screening is necessary to select the best variety in terms of growth, yield and performance against diseases (Menzi, 2003). The result of the study would significantly guide farmers in choosing the variety with resistance or tolerance to celery leafblight. Moreover, the use of celery varieties with resistance to leafblight would enable the farmers to save and consequently obtain higher income. Likewise, the use of resistant or tolerant variety of celery against leafblight would reduced the use of synthetic fungicides. Henceforth, detrimental effects from the use of fungicide would also be reduced. Furthermore, the quest for resistant variety of celery against leafblight is supportive to the advocacy of organic agriculture.

The study was conducted at the Benguet State University and within the Plant Pathology Department experiment area from March to June 2010.

REVIEW OF LITERATURE

Septoria Biology and Epidemiology

Septoria are *Ascomycete*s fungi that causes numerous leaf spot diseases on field crops, forages and many vegetables, and is responsible for yield losses (Landcare Research, 2005).

Septoria produces huge amounts of asexual spores in dark fruiting bodies, called pycnidia. The spores are hyaline (clear), thin, multicellular (2 - 4 cells), and about 20 to 60 um long (Walker, 1952). Pycnidia are formed on the older lesions and their development is encouraged by moist weather (Hawksworth *et al*., 1992 and Walker, 1952).

Septoria is seed borne and fruiting bodies can be found on the seed coat of the celery seed. The first appearance of the disease is thus in the seedbeds. Low levels of the disease occur throughout the growing season. Cool wet weather favors disease development of *Septoria*. Temperatures below 24 C or 75 F are conducive to disease formation. High humidity allows abundant production of spores and epidemics are initiated by splashing spores or by movement of spores by contact (Hawksworth *et al*., 1992 and Walker, 1952).

Spores that are splashed to healthy leaves germinate when moisture is available and produce a small fungal thread called a germ tube. This grows on the hosts' epidermis (skin) of the celery plant for a short distance then enters the leaf. The fungus proliferates internally within the leaf tissue and causes yellowing, then browning of the host. These are visible as leaf spots. Spores are formed on the surface of diseased areas

and the disease cycle continues as new spores are splashed to other healthy leaves (Hawksworth *et al*., 1992 and Walker, 1952).

The Leafblight Pathogen

Lacy (1994) reported that Septoria Leafblight is caused by *Septoria apiicola*. The disease overwinters on dead celery plant parts. The fungus is introduced in planting primarily through infected seed. Fungus in the seed dies within 2 years. The disease can be sprayed by water, equipment, and workers.

Lacy (1994) also describe the symptom as small, light yellow spots develop on leaves and petioles, gradually turning brown. Spots vary in shape and may coalesce if numerous. Minute, thickened, black dots (pycnidia) appear, containing spores of the fungus. Seriously infected leaves die. Symptoms on petioles are similar on those of leaves.

Varietal Attributes and Other Considerations

Selecting of variety to be planted is one of the most important decisions the commercial vegetable growers must consider. Thus, suggested varieties must perform well under a wide range of environment condition usually encountered in the individual farm. These considers their yield performance, posses excellent resistant against diseases and Insect pest, and the quality of harvested products desired by packers, shippers, wholesaler, retailers, and consumers, include size, shape, flavor and nutritional quality (Lorenz and Maynard, 1986).

Choosing variety is appropriate to minimize problem associated with water and fertilizer management (Kinoshita, 1972). Bautista *et al*., (1983) pointed that plants species or variety has a set of a genetic makeup and is termed genotype.

Varieties of the same kind are adaptable and thus, profitable and other varieties are not adaptable and thus, relatively unprofitable in some regions (Edmond *et al*., 1964).

Growing Celery

Janick (1972) stated that climatic, the summation of weather condition in an area, which involves temperature, relative humidity, and light are the factors of actions and interactions must be considered in physical environment and determine when, where that plant will grow.

Transplanting allows a better control of the environment during the early stage of plant growth, thus, giving the plant a head start. The lag period usually encountered during the initial phase of seedling growth is over by the time the seedlings are transplanted. Transplanting is always harmful to the plant but the amount of damage depends on the kind of vegetables, age of the plant, and the degree to which the plant was preconditioned for transplanting with adequate care. Any vegetable can be transplanted (Bautista and Mabesa, 1977).

Balliyao (1979) reported that transplanting seemed to delay the overall growth of plants as it took time for several roots and new foliage to generate.

Harvesting occurs when the average size of celery in a field is marketable; due to extremely uniform crop growth, fields are harvested only once. Petioles and leaves are removed and harvested celery are packed by size and quality (determined by color, shape,

straightness and thickness of petiole, stalk and midrib length and absence of disease, cracks, splits, insect damage and rot).

When properly stored in optimal conditions, celery can be stored for up to seven weeks between 0 to 2°C (32 to 36°F). Inner stalks may continue growing if kept at temperatures above 0°C (32°F). Freshly-cut petioles of celery are prone to decay, which can be prevented or reduced through the use of sharp blades during processing, gentle handling and proper sanitation. Celery contains essential, highly aromatic oil that lends its perfume and flavor to numerous dishes (Cantwell and Suslow, 2002).

Management and Control
of *Septoria apiicola*

Hawksworth et al. (1992) and Walker (1952) stated every effort should be made to acquire clean seeds. In the past, hot water treatment of seeds (48-49 ^{o}C for 30 mins) was used to effectively free seeds of this pathogen. Diseased fields should be cleaned following harvest and host material should not be left in the field. *Septoria* will survive in oil in decomposing celery tissue for months. New crops should not be planted adjacent to diseased crops to prevent rapid disease spread. Fields should be rotated to reduce early infection from the pathogen left from the previous crop

Likewise, Lacy (1994) recommends the treatment of 1 to 2- years-old seed in the water at 48^{o}C (118^{o}F) for 30 min, or use older seed as far early blight. Clean up propagation area thoroughly to insure no residue remains from the previous crop. Then, plow down crop refuses promptly after harvest and rotate both seedbeds and production fields so that celery is not grown in the same place for 3 or 4 years in a row. Afterwards, do not spread crop residues on production fields and Increase spacing between rows and reduce planting densities to improve air movement within the field.

MATERIALS AND METHODS

Seedbed Preparation, Seed and Seedling Management

A seedbed of 1m x 5m was prepared for sowing the celery seeds. Furrows were established in seedbeds at 2x5 cm apart. The seeds of the celery varieties were sown thinly along the furrows. The sown seeds were mulched with sack. When the seeds germinated, the sack mulchs were removed.

Six (6) weeks from sowing, celery seedlings were transplanted in the prepared polyethylene pots (Figure 1). Two seedlings were planted in each pot at 15cm apart. All cultural practices involved in caring celery seedlings such as watering, and control of insect pest were done in all the treatments. Seedlings were not protected with fungicides from germination to transplanting up to the termination of the experiment.

Figure 1. Overview of the experiment (35 DAT)

Treatment and Statistical Design

Black polyethylene bags measuring 12”x12” were used as potting material in the study. Each pots were filled with a mixture of sterilized compost and garden soil. Four pots consist a treatment per variety and per replication.

The design of the study was Completely Randomized Block Design (CRD) with four replications.

The treatments were:

Treatments (varieties)

V_1 – Amsa Celery (Amsa seeds)

V_2 – Tall Utah 5270 (Rushmore seeds)

V_3 – Chinese Celery (Kaneko seeds)

V_4 – Tall Utah (Kaneko seeds)

Data Gathered

1. Number of days to leafblight infection from transplanting. The observation started 7 days after transplanting and was continued daily until all the celery cultivars got infected with leafblight.

2. Leafblight infection rating. This was observed 7 days after transplanting and at weekly intervals for 8 weeks using the rating scale developed by the British Mycological Society (Anon, 1947).

Percentage	Description
0.1%	Only few plants affected here and there. Up to one (1) or two (2) spots.
1%	Up to 10 spots per plant
5%	About 50 spots per plant, or up to one (1) leaflet in ten (10) attacked.
25%	Nearly, every plant with lesions; plant still retaining normal form.
50%	Every plant affected and about half of the leaf area destroyed by blight: Field's looks green flecked with brown.
75%	About three (3) quarters of the leaf area destroyed by blight; field look either predominantly brown or green.
95%	Only a few leaves left green, but stems green.
100%	All leaves dead, stems dead or dying.

3. Reaction of the different varieties to leaf blight. This was observed at 63 days from transplanting using the CIP 2000 scale as follows:

Scale	Description	% Infection
1	Highly Resistant	1-20%
2	Moderately Resistant	20-40%
3	Susceptible	41-60%
4	Moderately Susceptible	61-80%
5	Very Susceptible	81-100%

4. Height of celery. Longest healthy leaves were measured at 35 and at 63 days after transplanting.

5. Meteorological data. Weather data were obtained at the PAG-ASA office at Balili, La Trinidad, Benguet during the conduct of experiments from March 2010-June 2010. The data obtained were:

a. Temperature (maximum and minimum in ^{o}C)

b. Relative Humidity (%)

c. Rainfall (mm)

RESULTS AND DISUSSION

Number of Days to Leafblight
Infection from Transplanting

Based on number of days to leafblight infection after transplanting, Tall Utah variety was the first to be infected within 12 days from transplanting. On the other hand, Tall Utah 5270, Amsa and Chinese Celery were infected after 18, 19 and 20 days respectively (Table 1). Statistical analysis show significant differences in the sensitivity of the varieties to leafblight infection at the early stage of growth.

Weekly Assessment of Leaftblight Infection

Recording of weekly of leafblight infection ratings was started 14 days after transplanting (Figure 2). Tall Utah being the variety that was infected early was significantly different from the other varieties. Amsa, Tall Utah 5270 and Chinese Celery had zero leafblight infection. In the third week of infection ratings, all varieties were infected with leafblight. Tall Utah leafblight infection was significantly higher than leafblight infections of the other varieties. Amsa, Tall Utah 5270 and Chinese Celery leafblight infection ratings were not significantly different.

Table 1. Number of days to leafblight *(Septoria apiicola)* infection after transplanting

CULTIVARS	MEAN
Amsa	19[c]
Tall Utah 5270	18[b]
Chinese Celery	21[d]
Tall Utah	13[a]
CV (%)	5.27%

Means with the same letter are not significantly different by DMRT (P0.05).

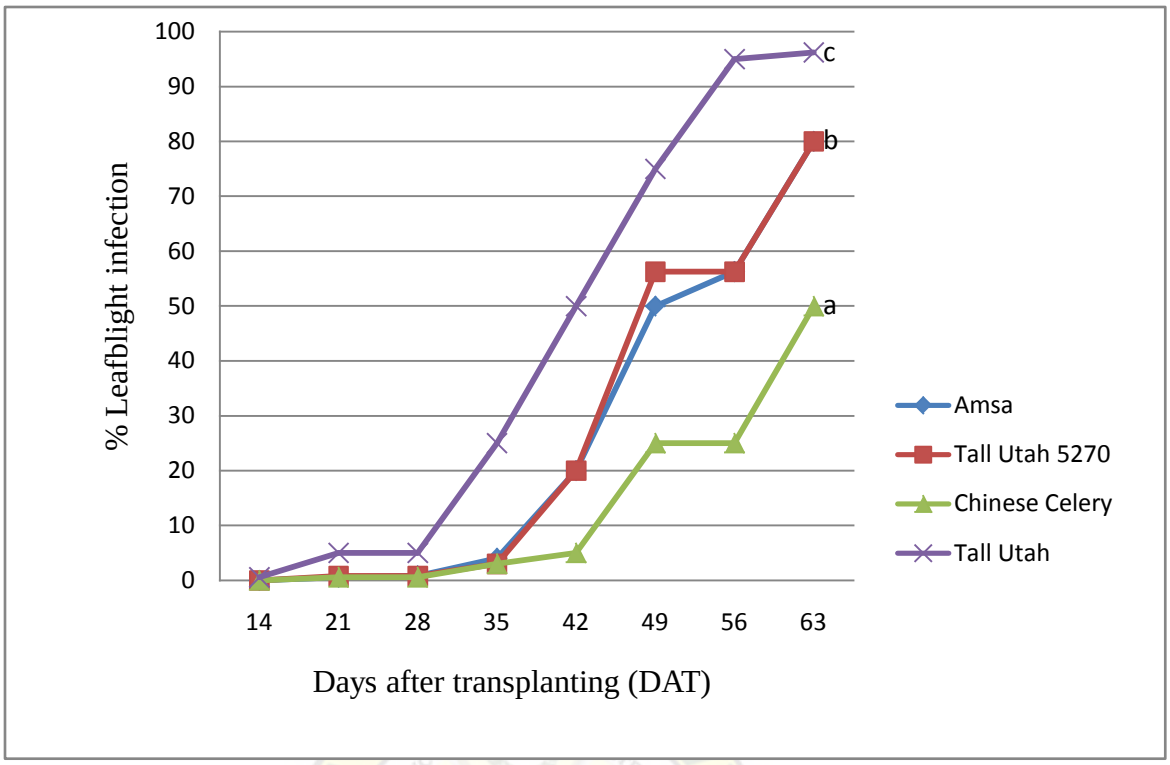

Figure 2. Weekly percent leafblight infection rating

The 4th (28 DAT) and 5th (35 DAT) weekly ratings showed an increase in leafblight infections however Amsa, Tall Utah 5270, and Chinese Celery varieties infection ratings were not significantly different, except for Tall Utah.

On the 6th (42 DAT) to the last week (63 DAT) of infection rating, Chinese Celery remained to have the lowest infection rating which is different from the other varieties (Figures 3-6).

Pathological Reaction

Among the four varieties, Tall Utah was observed to be very susceptible. Amsa and Tall Utah 5270 were classified as moderately susceptible, while Chinese Celery was classified as susceptible (Table 2).

Table 2. Pathological reaction of Celery against leafblight

CULTIVARS	% OF INFECTION	REACTION
Amsa	(61-80%)	Moderately Susceptible
Tall Utah 5270	(61-80%)	Moderately Susceptible
Chinese Celery	(41-60%)	Susceptible
Tall Utah	(81-100%)	Very Susceptible

Figure 3. Symptom of leafblight infection on cultivar Amsa (63 DAT)

Figure 4. Symptom of leafblight infection on cultivar Tall Utah 5270 (63 DAT)

Figure 5. Symptom of leafblight infection on cultivar Chinese celery (63 DAT)

Figure 6. Symptom of leafblight infection on cultivar Tall Utah (63 DAT)

Height of Celery

Results showed that initial height of celery measured at 35 days from transplanting and final height measured after 63 days from transplanting showed significantly difference between cultivars.

Table 3. Mean height of different celery cultivars at 35 (DAT) and 63 (DAT)

CULTIVARS	MEAN HEIGHT (cm)	
	INITIAL HEIGHT(35DAT)	FINAL HEIGHT (63DAT)
Amsa	335.55[b]	226.4[b]
Tall Utah 5270	334.35[b]	214.55[b]
Chinese Celery	408.05[c]	325.8[c]
Tall Utah	291.95[a]	107.5[a]

Means with the same letter are not significantly different by DMRT (P0.05).

The initial and final height of celery cultivars were measured from the base to the longest healthy leaf. Initial heights were higher than the final height due to the death of early and older leaves which were infected with leafblight. Therefore, final heights were lower as it has been measured from young and short leaves that were free from leafblight.

Meteorological Data

Average of weather data from April to June 2010 showed high relative humidity which ranged from 84.25 to 88%, temperature between 16.1 to 25.93 ^{o}C and rainfall from 13.58 to 29.73 mm (Table 4). These climatic conditions which prevailed during the conduct of the study favored lerafblight infection. Since, according to Hawksworth et al. (1992) and Walker (1952), lerafblight infection is favored by temperature range of 16-25 ^{o}C and relative humidity 89%.

Table 4. Meteorological data from April 2010- February 2010

	TEMPERATURE		RELATIVE HUMIDITY (%)	RAINFALL (mm)
	Min	Max		
April 2010				
Week 1	15.6	24.2	87	00
Week 2	15.9	25.6	81	21.7
Week 3	15.7	25.9	85	14.0
Week 4	17.2	25.4	84	57.6
Average	16.1	25.28	84.25	23.33

Table 4. Continued…

	TEMPERATURE		RELATIVE HUMIDITY (%)	RAINFALL (mm)
	Min	Max		
May 2010				
Week 1	17.4	25.9	84	18.9
Week 2	16.9	25.9	89	19.3
Week 3	17.3	26.1	87	73.8
Week 4	14.7	25.8	90	6.9
Average	16.58	25.93	87.5	29.73
June 2010				
Week 1	16.4	24.8	91	6.0
Week 2	19.3	24.8	88	9.7
Week 3	17.5	25.2	86	29.1
Week 4	17.1	25.0	87	9.5
Average	17.58	24.95	88	13.58

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted at Benguet State University, Plant Pathology Laboratory Area at La Trinidad, Benguet from March to June 2010. It aimed to screen cultivars of celery against septoria leafblight.

Tall Utah was observed to be most sensitive to celery leafblight as it was infected at the early days of growth (13 DAT) and progressively has the highest infection ratings as compared to Tall Utah 5270 (18 DAT), Amsa (19 DAT) and Chinese celery (21 DAT).

Based on the final percent infection rating, Tall Utah was the most susceptible and Chinese celery was the least susceptible to leaf blight. Amsa and Tall Utah 5270 were classified as moderately susceptible.

Temperature range of 16.1 ^{o}C - 25.93 ^{o}C, relative humidity of 84.25 % - 88%, and rainfall of 13.58 mm-29.73mm favored leafblight infection.

Conclusion

Chinese Celery exhibited the least leafblight infection which is descriptively susceptible, Amsa and Tall Utah 5270 were classified as moderately susceptible, while Tall Utah with the highest infection rating is describe as the most susceptible. Temperature range of 16.1 ^{o}C - 25.93 ^{o}C, relative humidity of 84.25 % - 88% favor leafblight infection.

Recommendation

It is recommended that a verification trial shall be conducted during dry and rainy season in the field to determine whether there is a significant difference between seasons. In addition, marketability or consumers preference of celery cultivars is also recommended to be considered for evaluation.

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APPENDICES

Appendix Table 1. Number of days to leafblight infection from transplanting

CULTIVARS	BLOCK				TOTAL	MEAN
	I	II	III	IV		
Amsa	18	19	19	20	76	19
Tall Utah 5270	18	18	19	20	75	18.75
Chinese Celery	21	20	20	21	82	20.5
Tall Utah	11	13	13	14	51	12.75
TOTAL	68	70	71	75	284	71
MEAN						17.75

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F
Treatment	3	140.50	46.83	105.38 **	3.49
Block	3	6.50	2.17	4.88	
Error	9	4.00	0.44		
TOTAL	15	151.00			

** - Highly significant C.V. = 3.76%

Appendix Table 2. Leafblight infection after 14 days from transplanting

CULTIVARS	BLOCK				TOTAL	MEAN
	I	II	III	IV		
Amsa	0	0	0	0	0	0
Tall Utah 5270	0	0	0	0	0	0
Chinese Celery	0	0	0	0	0	0
Tall Utah	1	0.1	1	0.1	2.2	0.55
TOTAL	1	0.1	1	0.1	2.2	0.55
MEAN						0.1375

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F
Treatment	3	0.91	0.30	4.48*	3.49
Block	3	0.20	0.07	1.00	
Error	9	0.61	0.07		
TOTAL	15	1.72			

* - Significant C.V. = 18.95%

Appendix Table 3. Leafblight infection after 21 days from transplanting

CULTIVARS	BLOCK				TOTAL	MEAN
	I	II	III	IV		
Amsa	1	0.1	1	0.1	2.2	0.55
Tall Utah 5270	1	1	1	0.1	3.1	0.775
Chinese Celery	1	0.1	1	0.1	2.2	0.55
Tall Utah	5	5	5	5	20	5
TOTAL	8	6.2	8	5.3	27.5	6.875
MEAN						1.71875

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F
Treatment	3	57.56	19.19	200.63**	3.49
Block	3	1.37	0.46	4.76	
Error	9	0.86	0.10		
TOTAL	15	59.78			

** - Highly significant C.V. = 17.99%

Appendix Table 4. Leafblight infection after 28 days from transplanting

CULTIVARS	BLOCK				TOTAL	MEAN
	I	II	III	IV		
Amsa	1	1	1	0.1	3.1	0.775
Tall Utah 5270	1	1	0.1	1	3.1	0.775
Chinese Celery	1	1	0.1	0.1	2.2	0.55
Tall Utah	5	5	5	5	20	5
TOTAL						7.1

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F
Treatment	3	56.61	18.54	137.30**	3.49
Block	3	0.18	0.27	2.00	
Error	9	1.21	0.13		
TOTAL	15	151.00			

** - Highly significant C.V. = 20.20%

Appendix Table 5. Leafblight infection after 35 days from transplanting

CULTIVARS	BLOCK				TOTAL	MEAN
	I	II	III	IV		
Amsa	5	5	5	1	16	4
Tall Utah 5270	5	1	5	1	12	3
Chinese Celery	5	5	1	1	12	3
Tall Utah	25	25	25	25	100	25
TOTAL	40	36	36	28	140	35
MEAN						8.75

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F
Treatment	3	1411.00	470.33	169.32**	3.49
Block	3	19.00	6.33	2.28	
Error	9	25.00	2.78		
TOTAL	15	1455.00			

** - Highly significant C.V. = 19.05%

Appendix Table 6. Leafblight infection after 42 days from transplanting

CULTIVARS	BLOCK				TOTAL	MEAN
	I	II	III	IV		
Amsa	25	25	25	5	80	20
Tall Utah 5270	25	5	25	25	80	20
Chinese Celery	5	5	5	5	20	5
Tall Utah	50	50	50	50	200	50
TOTAL	105	85	105	85	380	95
MEAN						23.75

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F
Treatment	3	4275.00	1425.00	25.65**	3.49
Block	3	100.00	33.33	0.60	
Error	9	500.00	55.56		
TOTAL	15	4875.00			

** - Highly significant C.V. = 31.38%

Appendix Table 7. Leafblight infection after 49 days from transplanting

CULTIVARS	BLOCK				TOTAL	MEAN
	I	II	III	IV		
Amsa	50	50	50	50	200	50
Tall Utah 5270	75	50	50	50	225	56.25
Celery Chinese	25	25	25	25	100	25
Tall Utah	75	75	75	75	300	75
TOTAL	225	200	200	200	825	206.25
MEAN						51.5625

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F
Treatment	3	5117.19	1705.73	43.67**	3.49
Block	3	117.19	39.06	1.00	
Error	9	351.56	39.06		
TOTAL	15	5585.94			

** - Highly significant C.V. = 12.12%

Appendix Table 8. Leablight infection after 56 days from transplanting

CULTIVARS	BLOCK				TOTAL	MEAN
	I	II	III	IV		
Amsa	75	50	50	50	225	56.25
Tall Utah 5270	75	50	50	50	225	56.25
Chinese Celery	25	25	25	25	100	25
Tall Utah	95	95	95	95	380	95
TOTAL	270	220	220	220	930	232.5
MEAN						58.125

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F
Treatment	3	9856.25	3285.42	63.08**	3.49
Block	3	468.75	156.25	3.00	
Error	9	468.75	52.08		
TOTAL	15	10793.75			

** - Highly significant C.V. = 12.42%

Appendix Table 9. Leafblight infection after 63 days from transplanting

CULTIVARS	BLOCK				TOTAL	MEAN
	I	II	III	IV		
Amsa	95	75	75	75	320	80
Tall Utah 5270	95	75	75	75	320	80
Chinese Celery	50	50	50	50	200	50
Tall Utah	100	95	95	95	385	96.25
TOTAL	340	295	295	295	1225	306.25
MEAN						76.5625

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F
Treatment	3	4467.19	1489.06	56.06**	3.49
Block	3	379.69	126.56	4.76	
Error	9	239.06	26.56		
TOTAL	15	5085.94			

** - Highly significant C.V. = 6.73%

Appendix Table10. Initial height of celery cultivars measured 35 DAT (cm)

CULTIVARS	BLOCK				TOTAL	MEAN
	I	II	III	IV		
Amsa	342	343.6	327.4	329.2	1342.2	335.55
Tall Utah 5270	353.2	333.2	318.2	332.8	1337.4	334.35
Chinese Celery	425.6	409	380.6	417	1632.2	408.05
Tall Utah	271.8	315.4	275	305.6	1167.8	291.95
TOTAL	1392.6	1401.2	1301.2	1384.6	5479.6	1369.9
MEAN						342.475

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F
Treatment	3	27867.31	9289.10	46.51**	3.49
Block	3	1607.69	535.90	2.68	
Error	9	1797.39	199.71		
TOTAL	15	31272.39			

** - Highly significant CV=4.13%

Appendix Table 11. Final height of celery cultivars measured 63 DAT (cm)

CULTIVARS	BLOCK				TOTAL	MEAN
	I	II	III	IV		
Amsa	280.4	182.8	248.8	193.6	905.6	226.4
Tall Utah 5270	275.4	230.6	174.6	177.6	858.2	214.55
Chinese Celery	300.8	346.8	329.8	325.8	1303.2	325.8
Tall Utah	109.2	114	122.4	84.4	430	107.5
TOTAL	965.8	874.2	875.6	781.4	3497	874.25
MEAN						218.5625

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F
Treatment	3	95649.15	31883.05	26.21**	3.49
Block	3	4251.09	1417.03	1.16	
Error	9	10947.86	1216.43		
TOTAL	15	110848.10			

** - Highly significant CV=15.96%