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The Effect of Protective Materials on the Overwintering of Hardy Annuals, Candytuft and Stocks

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THE EFFECT OF PROTECTIVE MATERIALS ON THE OVERWINTERING OF HARDY ANNUALS, CANDYTUFT AND STOCKS

by

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INTRODUCTION

Many hardy annual flowers will live through the winter if there is sufficient snow protection. Since snow cover is not consistent from year to year it has been suggested that hardy annuals planted in late summer and provided with some kind of protection before severe freezing begins will live through the winter successfully. Not only would this enable plants to bloom four to six weeks earlier, but would also enable gardeners to utilize flowers not commonly grown in northern Utah.

Some studies conducted at the Utah Experiment Station in Farmington have indicated that plants such as candytuft and snapdragons can be overwintered successfully with blooms developing several weeks earlier in the season than spring planted seeds.

The objective of this research was to determine the value of mulches or other protective materials to overwinter hardy annual flowers in Northern Utah.

REVIEW OF LITERATURE

The different kinds of plants vary in the extent to which they can withstand freezing temperatures and alternate freezing and thawing. Scarth (2) referred to three possible types of injury to plants due to freezing weather. He mentioned intracellular freezing of ice in the cells, extra-cellular freezing caused by alternate freezing and thawing, and the "physico-chemical" effects of dehydration. Vasil'yev (24) reported that Stiles (1930) had given an explanation of winterkilling of plants due to intracellular freezing. His report showed that the larger the ice crystals in the protoplasm the greater the destruction of cells. Quick freezing formed small ice crystals in the cells which enabled plants to survive low temperatures, whereas large ice crystals erupt the cell tissue which was very destructive. On the other hand, Levitt (13) stated that rapid freezing induced intracellular ice formation and was much more injurious than slow freezing. He also reported that repeated freezing and thawing of plant cells injured the plant much more than single or infrequent variations. Temperature fluctuation caused cell breakdown and could be observed when plants were thawed rapidly, Scarth (20) reported.

Chandler (4), Levitt (13), and Scarth (20) reported that much damage was done to plant cells when temperatures dropped so rapidly that water could not move out of the cells fast enough to prevent ice formation. Grim (9) suggested that winter killing took place in late February and early March when there was a great fluctuation of day and night temperatures. Tew (23) suggested that Chrysanthemums were more hardy in areas of sustaining cold than when grown where there was alternate freezing and thawing.

A number of research workers have found that snow cover, if consistent, would give enough protection to overwinter hardy plants. Lindquist, Grover, and Gram (14) found that spruce seedlings with a snow cover survived the winter. Vasil'yer (24) reported that a common practice in Russia was to plant fall grain in furrows so that the drifting snow would settle in the furrows and protect the plants. He also stated that snow would protect plants from drying out by adding moisture and reducing transpiration. Sprague (22) reported temperature underneath as little as 1-2/3 inches of snow was more stable than 2 inches of grass over clover stolons. Hawthorn and Pollard (11) stated that many hardy annuals could be overwintered in northern Utah if a constant snow cover was assured.

It has been suggested by some writers, Hands (10), Rockwell (19), Grim (9), Tew (23), Bruce (3), and Seely (21) that rather than applying mulches to keep the cold out, they should be used to keep the cold in or to keep the plants in cold storage. Creech and Hawley (7) reported that while organic mulches have been used by some to reduce fluctuation of soil temperature and reduce winter injury, they found that unmulched evergreen azaleas had the least amount of injury. However, unmulched plants made less growth than those mulched with 4 inches of hay. On the other hand McCrary and Lazaruk (15) showed that mulches were necessary on strawberry plants during the winter in South Dakota to protect them because the snow cover was not dependable. They reported that 2 inches of mulch was sufficient, and more than that would allow ice formation in the mulch. According to Vasil'yer (24) it was important to use protective materials during late fall frost because damage may occur then as well as during the winter. Miller and Waggoner (15) found that there was less fluctuation of temperature and reduced root desiccation where black plastic was used to mulch maple seedlings. Mulches should be light but bulky enough so they would not blow away according to Bruce (3), Grim (9), and Hands (10).

Some horticulturists have found that the size of plants going into the winter determined the amount of winter injury or killing. Clarke, Pollard, and Hawthorn (5) found that very young onion plants going into the winter were heaved out of the ground by alternate freezing and thawing. Riethmann (17) found candytuft planted in late August or early September survived the winter better at the Farmington field station than those planted earlier. Riethmann (18) reported early planted candytuft produced crooked stems. Boswell (1) reported that the size of cabbage plants in the fall was correlated with the tendency to form flower stalks the following spring. Kidman (12) reported that candytuft planted early in September survived the winter better than those planted earlier or later.

Some scientists have shown that desiccation was responsible for winter injury to plants. According to Brierley (2) desiccation may contribute to winter injury to fruit plants especially when the soil was frozen and interfered with water movement. Vasil'yer (24) reported that snow adds moisture to the atmosphere around the plants, thereby reducing damage from desiccation. Rockwell (19) also suggested that an anti-desiccant be used to reduce transpiration.

Riethmann (17) reported annual flowers that were planted at the right time in the fall would bloom 4 to 6 weeks earlier than those planted in the spring. Riethmann (18) also reported that some annual flowers developed a good quality bloom only in cool weather.

METHODS AND MATERIALS

These studies were conducted in the fall and winter months of 1963-64 and 1964-65 at the Farmington Field Station. During the first season four hardy annual flowers were selected as follows: Mixed and Iceberg candytuft, Shasta Giant Mix stocks and Burpeana asters. After the seed bed was carefully prepared, the seeds were planted on August 25, 1963.

Due to poor stands, four randomized plots (6) for each treatment of stocks and candytuft were selected where rather uniform stands existed. Each of the treatments was applied on December 4 to a 4 foot strip of plants with a plastic tent extending about 12 inches above the ground by means of wooden hoops. Protective materials used were clear polyethylene, and polyethylene over each of the following mulches: peat moss, pruning chips, wood-shavings, and straw. The mulches were spread over the entire ground area under the tents and placed so that only the top part of the plants was exposed. This required from 3 to 5 inches of mulch. The plastic tents were anchored to the ground on both sides and ends with soil.

Temperature recordings were taken in the various protective materials at ground level and another reading under the plastic in the upper part of the tent during the period of greatest variation in day and night temperatures from March 7 to March 24, 1964. The polyethylene tents were removed, the mulches scattered, and the count of plant survival was made on April 4, 1964.

Some changes were made in the 1964-1965 experiment. During the second season Early Giant Imperial stocks, Iceberg candytuft, Floradale snapdragon, Burpeana aster, and a pink larkspur were planted on August 19, 1964. Randomized plots (6) or rather uniform stands were selected for treatment with protective materials on stocks and candytuft. Asters and snapdragons were not included in the experiment because of very poor stands. The only reason for planting the selected strain of larkspur was to determine its hardiness without winter protection. Four randomized plots of stocks and three randomized plots of candytuft were selected.

The protective materials provided were: polyethylene clear plastic tents 60 inches long, 24 inches wide, and 15 inches high, similar tents of polyethylene with aluminum paint sprayed on the south and top of the tents, and the polyethylene aluminum tents over wood shavings, wood pruning chips, straw, and anti-desiccant (wilt-Pruf). The check plots consisted of exposed plants. The polyethylene tents were anchored with soil on the edges of the plastic, but unlike the 1963-64 experiment, the ends were left open to allow for air circulation. The stock plants were 3 to 4 inches high and the candytuft 5 to 6 inches high when the protective materials and tents were provided on December 2. (Refer to figures 3, 4, 5 and 6, for size of plants on December 2nd.)

Thermisters were placed on the ground under the protective materials next to the plants on January 26. Temperature readings were taken during critical weather changes until March 9. The tents were removed, and the number of plants which survived was counted on March 29.

Summary tables and figures are included in the text and appendix. Analyses of variance were computed and significant differences of means were determined by Duncan's New Multiple Range Test (8). Covariance analyses were used to adjust means of overwintering treatments to account for differences in stands of plants entering the winter.

Figure 1. View of polyethylene tents anchored with soil. December 4, 1963.

Figure 2. Temperature recording equipment between plot treatments, 1965.

Figure 3. Representative samples of stocks when protective materials were applied, December 2, 1964.

Figure 4. Representative samples of candytuft when protective materials were applied, December 2, 1964.

Figure 5. Representative samples of asters when protective materials were applied, December 2, 1964.

Figure 6. Comparison of plant growth, December 2, 1964.
Left to right: stocks, candytuft, asters.

EXPERIMENTAL RESULTS

Results of 1963-1964 research

The unusually warm weather late in the fall of 1963 allowed the plants to grow until about the middle of November. As a result, the plants were larger than desirable, in fact, the candytuft plants were budding out. During the latter part of November the temperature dropped below normal, and by December 4, when the protective materials and tents were placed over the plants, the soil had frozen to a depth of about 4 inches. The weather remained cold and relatively free from additional moisture until early February when there was a heavy snow which remained on the ground until about the middle of March.

As the days began to get warmer late in February, the nights remained cold which caused moisture to collect on the underside of the plastic tents. The plants appeared to have overwintered very well until early March. Then with several warm days the snow started to melt on the north side of the tents, and more moisture collected on the underside of the polyethylene. (See figure 7 for pattern of snow melting and moisture collection). There was a wide variation between the maximum and minimum air temperature just under the polyethylene tent. (Table 1 and Figure 8). The greatest variation between night and day temperature was 100°F which was recorded at the upper part of the tent or just under the plastic.

With the polyethylene tent closed on all four sides, the day temperature under the tent was much higher when the sun was shining.

Figure 7. Polyethylene tents showing moisture under plastic and snow melted on north side, March 7, 1964

Table 1. Temperature variations on different treatments and locations March 7-24, 1964

Treatment	Temperature ($^{o}F.$)		
	Maximum	Minimum	Variation
Air temperature under plastic	104	4	100
Platic at ground level	82	18	64
Plastic and chips	82	16	66
Plastic and straw	68	19	49
Plastic and peat moss	62	30	32
Plastic and shavings	60	30	30
Check (no treatment)	57	10	47
Ground level under snow	35	30	5

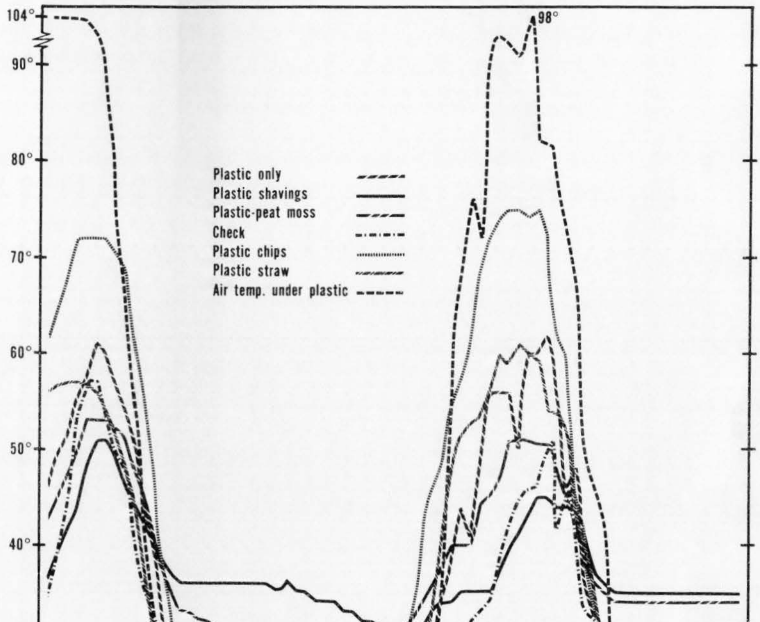

Figure 8. Temperature readings under protective materials at ground level next to plants March 7th and 8th, 1964.

than at night when the outside temperature would drop. With the sudden changes in temperature, the plants would be exposed to a growing climate during the day and dormant conditions at night.

Just prior to removing the tents, or about the middle of March, the plants began to deteriorate. When the tents were removed and the mulches cleared away, practically all of the plants had rotted. Upon closer observation, the roots appeared to be healthy even though the top growth had broken down.

Not one stock plant survived the overwintering or the rotting. On the other hand, the candytuft showed three treatments--plastic only, plastic and shavings, and plastic and straw, to have more

Table 2. Unadjusted means of candytuft surviving the winter as influenced by using protective materials, 1963-1964

Treatment	Treatment Mean Plant Survival	Significance Duncan's Multiple Range	
		.05	.01
Plastic only	3.00	a	a
Plastic-shavings	2.00	a b	a
Plastic-straw	1.00	b	a
Plastic-peat moss	.75	b	
Plastic-chips	.50	b	
Check (no treatment)	.25		

Survival which was highly significant over other treatments using unadjusted means (table 2). The adjusted means showed all treatments, except for the plastic and wood chips treatment to show higher survival and to be highly significant by using Duncan's (8) multiple range test. In other words, 99 times out of 100 we would expect all treatments except for plastic and wood chips to show a higher survival of overwintering plants. The adjusted means also showed the plastic and shavings, plastic and straw, and plastic and peat moss to be significant. To be significant, we would expect 95 times out of 100 trials that plastic and shavings, plastic and straw, and plastic and peat moss would show a higher percentage of overwintering of plants than other treatments in the experiment. The plastic and wood chips treatment had no significance in survival over the check or untreated plot in the adjusted means.

Table 3. Adjusted means of candytuft surviving the winter as influenced by using protective materials, 1963-1964

Treatment	Treatment Mean Plant Survival	Significance Duncan's Multiple Range	
		.05	.01
Plastic only	2.73	a	a
Plastic-shavings	1.97	a b	a
Plastic-straw	1.04	b	a
Plastic-peat moss	.91	b	a
Plastic-chips	.50		
Check (no treatment)	.35		

Results of 1964-1965

Larger plantings of candytuft and stocks were made on August 19, 1964, with plans of having larger trial plots. Unfortunately, a poor stand was obtained. Plants grew normally until there was cool weather early in November. When the tents were placed over the plants on December 2, the candytuft had grown taller than was desired. The ground had not frozen when the tents and protective materials were applied, and it remained unfrozen until the middle of December. There were about 4 inches of snow on the ground, and the plants appeared to be healthy when the thermisters were installed.

During February there were several days of freezing and thawing. According to temperature records taken at the field station Farmington, there were 15 days between February 15 and March 28th when the temperature for the day was 40°F or higher and the low for the day was 20°F or lower. During this period the temperature reached

Table 4. Extreme air temperature variations at Farmington Field Station, February 15 to March 28, 1965.

Date	Maximum	Minimum	Variation
February 15	37	2	35
February 26	62	18	44
March 18	42	7	35
March 19	34	8	26
March 20	42	12	30
March 21	62	42	20
March 22	62	42	20

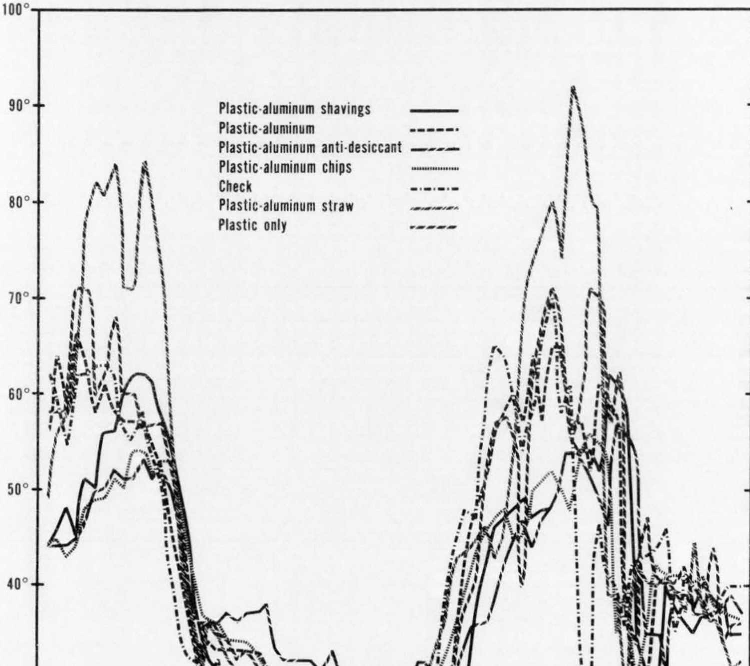

Figure 9. Temperature readings under protective materials at ground level next to plants March 7th and 8th, 1965.

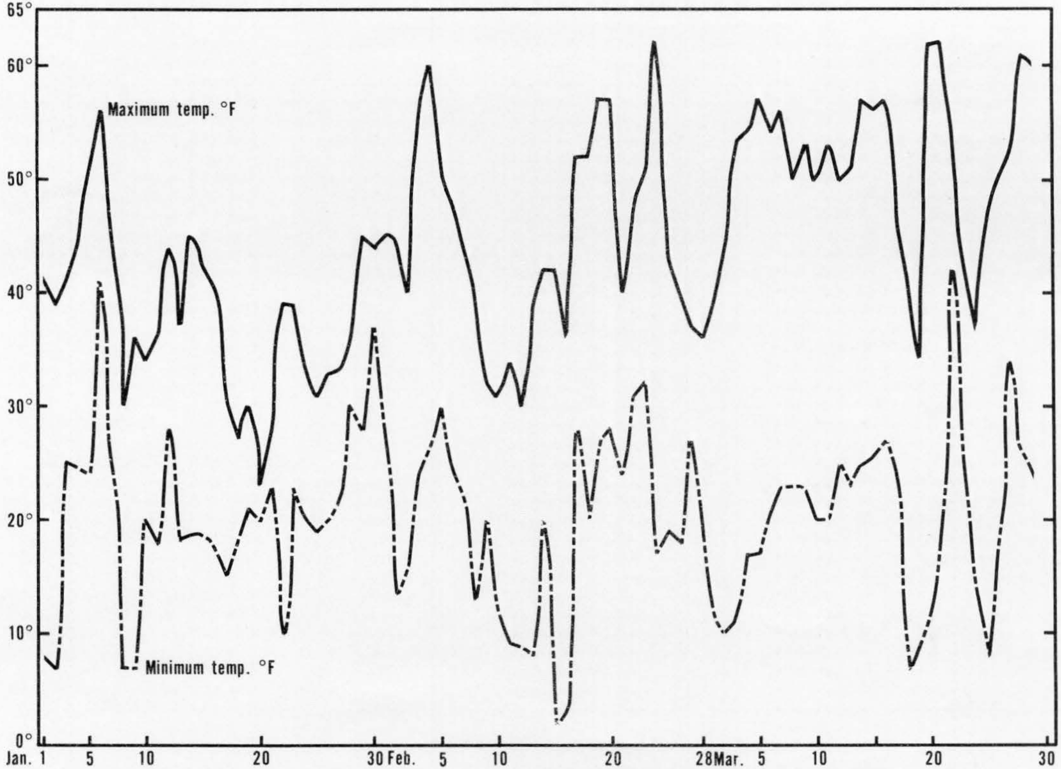

Figure 10. Maximum and minimum air temperatures at Utah Field Station, Farmington, Utah. January 1 to March 30, 1965.

a high of 62°F, and the low was 2°F. The plants took on a fresh green appearance about the middle of March. Then the minimum temperature dropped to 7°F and 8°F respectively on March 18th and 19th. On March 29, when the plants that overwintered were counted, it was found that many near the end of the tents had been killed after March 1st.

After records were taken on the winter survival of candytuft and data analyzed by adjusting survival of plants for difference in stand in the fall by covariance, the adjusted means, Table 5, showed significant differences in survival between plastic-aluminum, plastic-aluminum anti-desiccant, plastic-aluminum-straw, plastic-aluminum wood shavings, and plastic only over plastic-aluminum-wood chips, and no treatment.

Table 5. Adjusted means of candytuft surviving the winter as influenced by using protective materials, 1964-1965

Treatment	Treatment Mean Plant Survival	Significance Duncan's Multiple Range .05	
Plastic-aluminum	12.19	a	
Plastic aluminum anti-desiccant	12.08	a	b
Plastic-aluminum-straw	9.53	a	b
Plastic-aluminum-shavings	7.59	a	b
Plastic only	6.17	a	b
Plastic-aluminum-wood chips	5.88		b
Check (no treatment)			

Unadjusted means, Table 6, showed significance of plastic-aluminum-anti-desiccant, plastic-aluminum, plastic-aluminum-straw, and plastic-aluminum-shavings in plant survival over plastic only and plastic-aluminum-wood chips. There was significance of the plastic-aluminum, plastic-aluminum-straw, plastic-aluminum-shavings, and plastic only in overwintered plants over plastic-aluminum-wood chips. Plastic-aluminum-straw, plastic-aluminum shavings, plastic only, and plastic-aluminum-wood chips had significance over the no treatment.

Table 6. Unadjusted means of candytuft surviving the winter as influenced by using protective materials, 1964-1965

Treatment	Treatment Mean Plant Survival	Significance Duncan's Multiple Range .05
Plastic-aluminum anti-desiccant	15.33	a
Plastic-aluminum	13.67	a b
Plastic-aluminum-straw	8.33	a b c
Plastic-aluminum-shavings	8.00	a b c
Plastic only	5.33	b c
Plastic-aluminum-chips	4.33	c
Check (no treatment)	.33	

This is the first time stocks have been overwintered under similar weather conditions to the knowledge of the author. By running the data for adjusted means, protective materials used for overwintering stocks showed high significance. Plastic-aluminum,

Table 7. Adjusted means of stock surviving the winter as influenced by using protective materials, 1964-1965.

Treatment	Treatment Mean Plant Survival	Significance Duncan's Multiple Range	
		.05	.01
Plastic-aluminum	24.32	a	a
Plastic only	23.56	a	a
Plastic-aluminum-anti desiccant	17.43	a b	a b
Plastic-aluminum-wood chips	10.43	b c	b c
Plastic-aluminum-shavings	7.63	c d	c
Plastic-aluminum-straw	3.21	d	c
Check (no treatment)	0.42		

Table 8. Unadjusted means of stock surviving the winter as influenced by using protective materials, 1964-1965.

Treatment	Treatment Mean Plant Survival	Significance Duncan's Multiple Range	
		.05	.01
Plastic only	29.00	a	a
Plastic-aluminum	27.00	a	a b
Plastic-aluminum anti-desiccant	17.50		b c
Plastic-aluminum-chips	6.75		c
Plastic-aluminum-shavings	5.75		
Plastic-aluminum-straw	1.00		
Check (no treatment)	.00		

plastic only, and plastic-aluminum-anti-desiccant showed high significance in plant surivival over other treatments. Unadjusted means shows plastic only and plastic aluminum significantly different in plant survival over other treatments. No direct correlation could be detected between temperature readings in the mulches as seen in Figure 9 and the significant relationship of the protective materials.

Even though the asters were not protected with any of the mulches, some plants survived the winter, but were killed when the temperature dropped to 7°F on March 18th. The larkspur survived the winter without any artificial protection, and the plants bloomed early in the spring of 1965. Even though some exposed candytuft and stocks were sprayed with an anti-desiccant, no plants survived the winter of 1964-1965.

DISCUSSION

It is apparent after 2 years of research that protective materials do have value in overwintering hardy annual flowers. The use of plastic only, plastic and shavings, and plastic and straw was highly significant in overwintering candytuft during the 1963-64 season, whereas all mulches and protective materials were significant in overwintering plants over the no-treatment.

Stocks did not overwinter during the 1963-64 season, but were successfully overwintered in the 1964-65 season by using different protective materials. Stock plants broke down rapidly in the spring of 1964 when there was a great variation in day and night time temperature.

Whether or not the ground was frozen when the protective material was applied seemed to make no difference. When the protective material was applied on December 4, 1963, the soil was frozen to a depth of about 4 inches, and when the protective material was applied on December 2, 1964, the soil was not frozen.

The plants appeared healthy until about the middle of February both seasons when day temperatures began warming, but night temperatures remained cold. It appeared from these results that it is advisable during February and early March to have the tents open to allow air to circulate.

In general, plastic, plastic sprayed with aluminum, or plastic-aluminum, and anti-desiccant appeared to be adequate protection for the young seedling. The use of mulch along with the plastic was not necessarily advantageous.

SUMMARY

During the winters 1963-1964 and 1964-1965, protective materials were used on hardy annual flowers to determine if they could be overwintered in Northern Utah. In August 1963, candytuft, stocks, and asters were planted at the Utah field station in Farmington. Protective materials used were: polyethylene, polyethylene-peat moss, polyethylene-straw, polyethylene-wood chips, and polyethylene-wood shavings. In August 1964, candytuft, stocks, snapdragons and larkspur were planted. Candytuft and stocks were protected with polyethylene, polyethylene-aluminum, polyethylene-aluminum-anti-desiccant, polyethylene-aluminum-straw, polyethylene-aluminum-wood shavings, polyethylene-aluminum-wood chips.

It was found through this research, that a greater number of plants overwintered where the polyethylene tents were left open on the ends so that the air around the plants was about the same temperature as the outside air. It was also found that there was no advantage of using mulches with the polyethylene. Plots treated with polyethylene, and polyethylene sptrayed with aluminum showed as high a plant survival as those where polyethylene and mulches were used.

The critical period when plants need protection is in late February and during March when there is a great variation between day and night temperatures. If plants can be kept in a semidormant condition until day and night temperatures reach a climate for growth, it is the belief of the author that candytuft and stocks can be overwintered satisfactorily in Northern Utah.

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APPENDIX

Table 9. Analysis of variance of candytuft overwintered as influenced by using protective materials. Unadjusted means of numbers of plants surviving the winter 1963-1964.

Treatment MEANS ranked in order

1	2	4	6	3	5
.25	.50	.75	1.00	2.00	3.00

Analysis of variance

Source	D.F.	M.S.	F.	.05	.01
Treatment	5	4.4000	**5.2105	2.9013	4.5556
Error	15	.8444			

Standard Error of the Mean

$$S_{\bar{x}} \sqrt{\frac{.8444}{4}} = \sqrt{.2111} = .4594$$

Least significant range

	2	3	4	5	6
.05	1.38	1.45	1.49	1.52	1.54
.01	1.92	2.01	2.07	2.10	2.17

Table 10. Analysis of variance of candytuft overwintered as influenced by protective materials. Adjusted means of plants surviving the winter 1963-1964.

Treatment MEANS ranked in order

1	2	4	6	3	5
.35	.50	.91	1.04	1.97	2.73

Analysis of variance

Source	D.F.	M.S.	F.	.05	.01
Treatment	5	3.0137	*4.0379	2.9582	4.6950
Error	14	.7464			

Standard Error of the Mean

$S_{\bar{x}} \sqrt{.7464} = \sqrt{.1866} = .4319$

Least significant range

	2	3	4	5	6
.05	1.31	1.37	1.41	1.44	1.46
.01	1.82	1.91	1.97	2.00	2.03

Table 11. Analysis of variance of candytuft overwintered as influenced by using protective materials. Adjusted means of plants surviving the winter 1964-1965.

Treatment MEANS ranked in order

1	7	2	6	5	3	4
1.88	5.88	6.17	7.59	9.53	12.08	12.19

Analysis of variance

Source	D.F.	M.S.	F.	.05	.01
Treatment	6	33.8332	*3.36999	3.0946	5.0692
Error	11	10.0396			

Standard of Error of the mean

$$S_{\bar{x}} \sqrt{\frac{10.0396}{3}} = \sqrt{3.3456} = 1.8293$$

Least significant range

	2	3	4	5	6	7
.05	5.69	5.98	6.13	6.20	6.27	6.29

Table 12. Analysis of variance of candytuft overwintered as influenced by using protective materials. Unadjusted means of plants surviving the winter 1964-1965.

Treatment MEANS ranked in order

1	7	2	6	5	4	3
.33	4.33	5.33	8.00	8.33	13.67	15.33

Analysis of variance

Source	D.F.	M.S.	F.	.05	.01
Treatment	6	82.6349	*3.7612	2.9961	4.8206
Error	12	21.9683			

Standard Error of the Mean

$$S_{\bar{x}} \sqrt{\frac{21.9683}{3}} = \sqrt{7.3228} = 2.7061$$

Least significant range

.05	2	3	4	5	6	7
	8.33	8.74	9.01	9.09	9.20	9.25

Table 13. Analysis of variance of stocks overwintered as influenced by using protective materials. Adjusted means of plants surviving the winter 1964-1965.

Treatment MEANS ranked in order

1	5	6	7	3	2	4
.42	3.51	7.63	10.43	17.43	22.56	24.32

Analysis of variance

Source	D.F.	M.S.	F.	.05	.01
Treatment	6	225.6724	**11.5419	2.6987	4.1015
Error	17	19.5524			

Standard Error of the Mean

$$S_{\bar{x}} \sqrt{\frac{19.5524}{4}} = \sqrt{4.8881} = 2.2109$$

Least significant range

	2	3	4	5	6	7
.05	6.59	6.92	7.12	7.25	7.36	7.43
.01	9.06	9.51	9.75	9.95	10.08	10.24

Table 14. Analysis of variance of stocks overwintered as influenced by using protective materials. Unadjusted means of plants surviving the winter 1964-1965.

Treatment MEANS ranked in order

1	5	6	7	3	4	2
.00	1.00	5.75	6.75	17.50	27.00	29.00

Analysis of variance

Source	D.F.	M.S.	F.	.05	.01
Treatment	6	583.0595	**6.2192	2.6613	4.0146
Error	18	24.7013			

Standard Error of the Mean

$$S_{\bar{x}} = \sqrt{\frac{24.7013}{4}} = \sqrt{6.1753} = 2.4850$$

Least significant range

	2	3	4	5	6	7
.05	7.38	7.75	7.98	8.13	8.25	8.32
.01	10.11	10.61	10.88	11.09	11.26	11.41

Figure 11. Close-up of plants through clear polyethylene tent, March 15, 1965

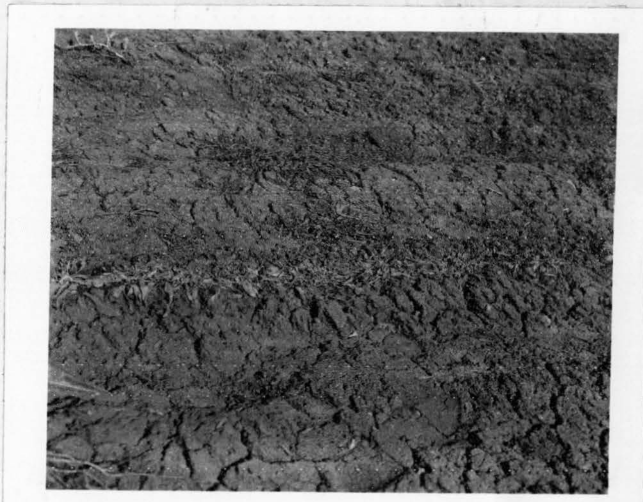

Figure 12. Plants March 15, 1965, after being unprotected during winter.

Figure 13. Close-up of candytuft with polyethylene removed, March 15, 1965

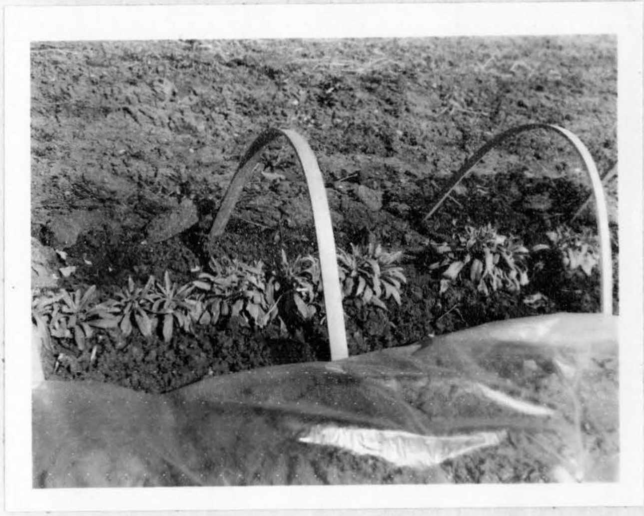

Figure 14. Close-up of stocks with polyethylene removed, March 15, 1965

Figure 15. Close-up of stocks in straw with polyethylene removed March 15, 1965.

Figure 16. Close-up of stocks in wood chips after polyethylene was removed, March 15, 1965.

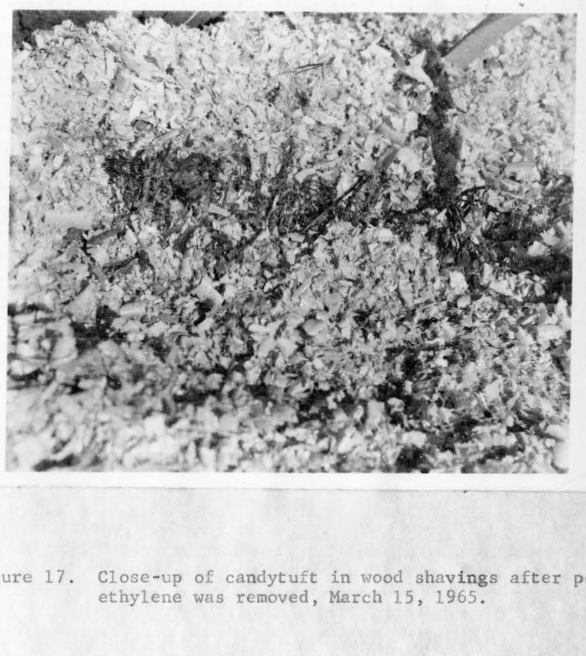

Figure 17. Close-up of candytuft in wood shavings after poly-
ethylene was removed, March 15, 1965.

Figure 18. Stock plants in wood shaving mulch after polyethylene was removed, March 15, 1965.

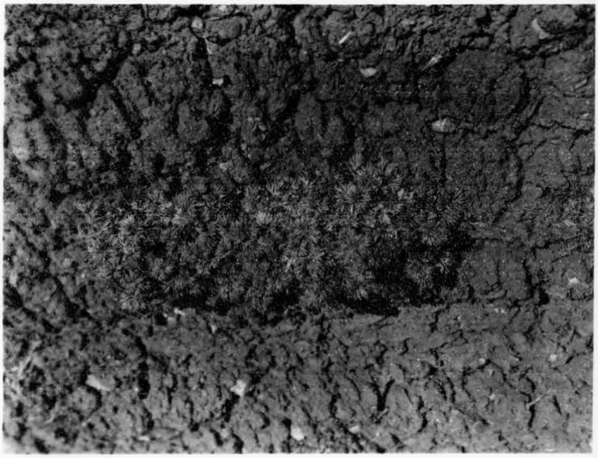

Figure 19. Larkspur overwintered with no treatment. March 15, 1965.