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Flower Seed Production Trials in Southern Oregon

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Abstract

Forty species of flowers were grown for seed production in greenhouse and field trials during a three-year period beginning in 1970 at the Southern Oregon Experiment Station, Medford, Oregon. Selected for testing were species expected to adapt to soil and climatic conditions of the area. Herbicide trials were conducted on the flower species in the greenhouse before they were grown in the field. Most were found to be tolerant of selective rates of one or more herbicides that control many annual weeds in field plantings. Some were tolerant of several herbicides and combinations of herbicides. Information gained on herbicide tolerances was successfully applied in field trials.

Field trials to evaluate adaptabilities and yield potentials were conducted with the flower species. Establishment procedure, growth habit, maturity range, seed shatter potential, and harvest methods were studied. Seed yields were determined with most species and activities of bees and other pollinating agents were observed on a number of species.

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Flower Seed Production Trials in Southern Oregon

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Flower seed production is a very specialized business requiring a high degree of management, some special equipment, and favorable soil and climatic conditions. The industry is centered in California but commercial seed companies are interested in finding alternative production areas because of changing land use patterns. Relatively small acreages are involved in growing many of the flower species, and nearly all are grown under a commercial seed company contract.

Turfgrass, forage, sugar beet, and vegetable seed crops have been grown successfully for many years in the Southern Oregon area which includes Jackson, Josephine, and parts of Douglas counties. Flowers grown for seed could become important alternative, intensive crops, entering a rotation with other seed and specialty crops. The machinery requirement for flower seed production is quite similar to that of the other seed crops. Although soil and climatic conditions in the area appeared to be favorable for flower seed production, there was a need for information that could best be obtained by experimental plantings of a number of flower species.

Because of grower and seed company interest and the need for information, the feasibility of growing flowers for seed was studied at the Southern Oregon Experiment Station, Medford, Oregon during a three-year period, beginning in 1970. Forty flower species were grown in various greenhouse and field trials. Although there are many varieties of some species available, most experiments involved only a single variety of each.[1]

Seed production fields of any crop should be as weedfree as practical to lessen competition to the crop, make harvest and seed processing easier, and to ensure the purity of the final product. Since little information was available from the major production areas concerning the herbicide tolerances of flowers grown for seed, experiments were conducted in the greenhouse with nearly all the flower species before they were grown in the field. Part I of this report covers flower seed trials involving herbicides.

Information gained from the herbicide trials was successfully applied in seed production studies in the field. Part II concerns several aspects of seed production in the field.

Final evaluations were made by placing most of the species in adaptability groups based on seed production potentials. Part III of this report concerns the adaptabilities of the flower species for seed production in southern Oregon.

Part I: Herbicide Tolerances

Methods

Herbicides known to control many annual weed species in field plantings were applied at rates used in field applications on several other crops. They involved pre-plant incorporated, pre-emergence, and post-emergence treatments in screening-type trials. A Central Point loam soil was used in greenhouse flats which had a depth of 2.5 inches.

Five herbicides were used as pre-plant incorporated treatments. They were benefin (Balan), bensulide (Prefar), EPTC (Eptam), nitralin (Planavin), and trifluralin (Treflan). The herbicides were thoroughly mixed with the soil almost immediately after being applied to the soil surface.

Four herbicides were used as pre-emergence treatments. They were chloroxuron (Norex, Tenoran), chlorpropham (CIPC), DCPA (Dacthal), and nitrofen (TOK). They were sprayed over the soil surface within three days after the flower species were seeded. Chloroxuron and nitrofen also were used as post-emergence treatments.

All herbicides were applied in approximately 40 gallons of solution per acre, using a plot sprayer equipped with a boom and fan-type nozzles. Untreated checks were left in all the trials. Herbicidal effects were evaluated by stand estimates and growth measurements, generally 30 to 60 days after treatment.

[1] Seeds for the tria'ls were provided by the Ferry-Morse Seed Company, Mountain View, California 94040.

Results and Discussion

Most of the flower species were found to be tolerant of one or more of the herbicides used in the trials. Exceptions were celosia, iceland poppy, shirley poppy, ornamental basil, and vinca which were found to have little or no tolerance to the several herbicides. Table 1 presents a summary of each flower species' herbicide tolerance in terms of rates per acre as determined in the greenhouse and confirmed in field trials on the Central Point sandy loam soil.

Such flower species as ageratum, alyssum, centaurea, cosmos, dahlia, eschscholtzia, gaillardia, stock, and zinnia were found to tolerate several different herbicides. In field trials, combinations of pre-emergence and post-emergence or pre-plant incorporated and pre-emergence treatments were effectively used with several flower species that had broad herbicide tolerances. With those species showing little or no herbicide tolerance, cultivation and handweeding were necessary. It was not possible, however, to test all the flower species with the complete array of treatments. Further tests are underway to evaluate additional chemicals in an effort to improve weed control methods in flower seed production, and to study the effectiveness of desiccants for crop drying as an aid to seed harvest.

While each herbicide used in the trials is registered on one or more field, vegetable, small fruit, or tree fruit crops, few are registered for use on flowers grown for seed. A number of the herbicides are registered for use on ornamentals, however.

Table 1. Tolerances of flower species to herbicides, in pounds of active ingredient per acre, as determined in greenhouse trials on a Central Point sandy loam soil*

	Pre-Plant Incorporated					Pre-Emergence			Post-Emergence	
Flower Species	Benefin (Balan)	Bensulide (Prefar)	EPTC (Eptam)	Nitralin (Planavin)	Trifluralin (Treflan)	Chloroxuron (Norex, Tenoran)	Chloropropham (CIPC)	DCPA (Dacthal)	Nitrofen (TOK)	Chloroxuron (Norex, Tenoran)	Nitrofen (TOK)
Ageratum	1.5	6.0	2.0	1.0	0.75	.....	6.0	9.0	5.0	4.0	3.0
Alyssum	1.5	.....	.....	1.5	0.75	0	0	6.0	5.0	4.0	5.0
Aster	1.0	.....	.....	1.0	0.75	.....	.....	.....	.....	.....	.....
Balsam	1.5	6.0	2.0	1.5	0.75	.....	0	9.0	5.0	0	0
Calendula	1.5	6.0	3.0	1.5	0.75	0	3.0	9.0	4.0	0	0
Candytuft	1.5	6.0	0	1.5	0.75	.....	0	9.0	4.0	0	0
Carnation	0	3.0	2.0	0	0	.....	0	0	5.0	0	4.0
Celosia	0	0	0	0	0	0	0	6.0	0	0	0
Centaurea	1.5	3.0	2.0	1.0	0.75	3.0	3.0	9.0	5.0	3.0	3.0
Cleome	0	6.0	0	0	0	.....	0	6.0	4.0	0	0
Cosmos	1.5	.....	.....	1.5	0.75	4.0	6.0	9.0	5.0	4.0	5.0
Dahlia	1.5	.....	.....	1.0	0.75	.....	.....	.....	5.0	4.0	5.0
Delphinium	.....	.....	.....	.....	0.50	0	0	9.0	0	.....	.....
Dianthus	0	0	2.0	0	0	.....	0	0	5.0	0	3.0
Dimorphotheca	1.5	.....	.....	1.5	0.75	.....	.....	.....	.....	.....	.....
Eschscholtzia	1.5	3.0	2.0	1.5	0.75	.....	0	9.0	5.0	3.0	3.0
Gaillardia	1.5	3.0	3.0	1.5	0.75	0	3.0	6.0	4.0	0	4.0
Gypsophila	0	3.0	3.0	0	0	.....	0	0	5.0	0	0
Helichrysum	1.5	.....	.....	1.0	0.75	.....	.....	.....	.....	.....	.....
Hollyhock	1.5	6.0	0	1.0	0.75	.....	0	9.0	0	3.0	0
Iberis	1.5	6.0	0	1.5	0.75	.....	0	0	4.0	0	3.0
Iceland Poppy	.....	.....	.....	.....	0	0	0	0	0	.....	.....
Larkspur	1.0	3.0	0	0	0.50	.....	0	9.0	5.0	0	0
Lupin	1.0	6.0	2.0	1.0	0.50	.....	0	9.0	4.0	0	0
Marigold	.....	.....	.....	.....	0.75	4.0	4.0	9.0	3.0	.....	.....
Myosotis	0	0	2.0	0	0	.....	0	0	3.0	0	0
Nicotiana	1.5	.....	.....	1.0	0.75	.....	.....	.....	.....	.....	.....
Ornamental Basil	0	3.0	0	0	0	0	0	0	0	0	0
Pansy	1.0	6.0	3.0	.....	0.50	.....	0	0	0	0	0
Petunia	1.0	.....	.....	.....	0.50	0	0	0	0	.....	.....
Portulaca	0	3.0	2.0	0	0	.....	0	0	0	0	0
Salvia	1.0	3.0	0	0	0.50	.....	0	9.0	3.0	0	0
Shirley Poppy	0	.....	.....	0	0	0	0	0	0	.....	.....
Snapdragon	0.75	3.0	0	0	0.37	.....	0	0	0	0	0
Stock	1.0	.....	.....	.....	0.75	.....	.....	.....	5.0	4.0	5.0
Sweet William	0	6.0	3.0	0	0	.....	0	0	5.0	4.0	4.0
Verbena	1.0	6.0	0	1.0	0.50	0	0	0	0	0	0
Vinca	0	0	.....	0	0	.....	0	0	0	0	0
Zinnia	1.5	.....	.....	1.5	0.75	4.0	6.0	9.0	5.0	3.0	0

* A blank space at a location in a column indicates the herbicide was not tested on that flower species. A zero (0) indicates a lack of tolerance to an effective rate of the herbicide.

Part II: Seed Production

Cultural Methods

Flower species grown in the herbicide tolerance trials in the greenhouse were seeded in field plots during the three-year period to assess their seed production potentials and general adaptabilities to the area and to identify and study some problems that would be associated with commercial seed production.

Seedbeds were prepared by plowing, disking, spring-toothing, and harrowing. Fertilizers were broadcast during seedbed preparation in the amounts of 80 to 100 pounds of nitrogen, 60 to 80 pounds of phosphate (P_2O_5), 60 to 80 pounds of potash (K_2O), and 40 to 60 pounds of sulfur per acre. An additional 40 to 60 pounds of nitrogen per acre were broadcast during the growing season for some of the larger, long-season flower species.

Herbicides were applied pre-plant incorporated, pre-emergence, or post-emergence based on each flower specie's tolerance as determined in greenhouse tests. Cultivation and a certain amount of handweeding were done, especially in those flower species not receiving a herbicide.

All seeds were treated with thiram (Arasan 75) dry fungicide and were seeded with a Planet Jr. seeder. The row spacing was 20 inches with five rows per plot in 1970 and with four rows per plot in 1971 and 1972, and with a row length of 100 feet.

Stands of some of the larger flower species are usually blocked or thinned to allow sufficient space among plants for optimum development of seed heads. Normally, one to three plants are left in clusters separated by a space of five to six inches in the row. In the field trials, calendula, carnation, cosmos, dahlia, dianthus, helichrysum, hollyhock, nicotiana, stock, sweet william, and zinnia were blocked.

Overhead sprinklers were used to apply irrigation water during the first part of the 1970 season and during all the 1971 and 1972 seasons. Furrow irrigation was used after June 1, 1970. The sprinklers did not appear to cause excessive lodging or seed loss, or to be a contributing factor in foliar diseases.

Honeybees were provided for pollination. Bumblebees, other wild bees (Halictus sp.), certain moths, and hummingbirds were present as pollinating agents. Insect pests were not present in large numbers except for lygus bugs in 1970. An application of one pound of Dylox per acre provided effective control.

Powdery mildew was evident in zinnias in 1970 and 1971. To control it, dusting sulfur was applied at the rate of 30 pounds per acre in late August. Dahlia, larkspur, snapdragon, and stock were affected by root rots which appeared to have been encouraged by frequent irrigation. Diseases were not problems in other species.

Harvest Methods

Seed losses from shattering (seeds falling to the ground) were found to be a problem with many flower species as they matured. Wind and rain near maturity, handling during swathing or during elevation of swathed material into the threshing unit, and seed pods opening during drying in the swath contributed to the losses.

To minimize seed losses, many flower species were placed on canvas tarps as they were cut so seeds normally lost during drying would be retained on the tarps. A 40-inch-wide plot-type combine was used to thresh the seeds, either as a stationary machine for plant materials on the tarps, or as a combine for those flower species that were direct-harvested. Because of uneven maturity, heads of helichrysum and pansy were picked by hand as seeds matured during the season.

Commercial swathers are sometimes equipped to lay the plant material on a 48-inch or wider strip of paper that is unrolled behind the cutter bar. When the material on the paper has dried, a combine harvester separates the seed from stems, leaves, chaff, and paper.

1970 RESULTS

Results for the individual flower species are presented in the following discussions. Summary data are presented in Table 2.

1. Alyssum (*Alyssum procumbens*): Two varieties, Carpet of Snow and Royal Carpet, were seeded April 3 and both emerged quickly and grew vigorously. There were blossoms on the plants from June 1 until the plants were cut October 6. Honeybees were attracted to the flowers, particularly late in the season. Seed yields were rather low, amounting to 127 pounds per acre for the Carpet of Snow and 96 pounds per acre for the smaller Royal Carpet.

Alyssum could be grown in the Southern Oregon area although seed harvest can be difficult. In commercial production, plants are undercut about an inch below ground level and are combined after

Table 2. Summary of flower seed cultural and yield data, Southern Oregon Experiment Station, Medford, 1970

Flower Species	Seeding Date	Planter Plate Hole Setting[1]	Herbicide Used,[2] (Pounds/acre)	Harvest Date	Cutting Method	Shatter Hazard	Seed Yield, (Pounds/acre)
Alyssum							
Carpet of Snow	April 3	2	trifluralin 0.5	Oct. 6	swathed	moderately high	127
Royal Carpet	April 3	2	trifluralin 0.5	Oct. 7	swathed	moderately high	96
Aster	April 3	10	trifluralin 0.5	Nov. 13	combined	moderate	389
Carnation	April 3	9	none	not harvested, immature seeds			
Dianthus	April 3	9	none	Sept. 17	combined	moderate	233
Dimorphotheca	April 3	35	benefin 1.0	July 10	swathed	very high	238
Helichrysum	April 3	9	benefin 1.0	Aug.-Oct.	hand pick	high	124
Larkspur	April 3	9	benefin 1.0	Sept. 10	swathed	moderate	62
Pansy	April 3	3	benefin 1.0	Aug.-Sept.	hand pick	high	not est.
Petunia	April 3	47	benefin 1.0	Sept. 28	swathed	high	263
Snapdragon	April 3	41	trifluralin 0.37	not harvested; replanted because of poor stand			
Stock							
Dwarf 10 Weeks	April 3	9	benefin 1.0	Sept. 24	swathed	low	261
Giant Imperial	April 3	9	benefin 1.0	not harvested, immature			
Dahlia	April 21	31	benefin 1.0	Oct. 7	swathed	moderate	21
Nicotiana	April 21	41	benefin 1.0	Sept. 24	hand clip	high	435[3]
Cosmos	May 1	26	benefin 1.0	Sept. 8	combined	high	161[3]
Ornamental Basil	May 1	5	none	Sept. 16	swathed	low	747
Portulaca	May 1	1	none	Sept. 17	swathed	high	60[3]
Zinnia							
Giant Double	May 1	34	benefin 1.0	Oct. 9	combined	moderate	115
Tetra Mix	May 1	34	benefin 1.0	Oct. 9	combined	moderate	48

1. Planter plate hole setting is for a Planet Jr. type seeder used in the trials.
2. Tradenames of the herbicides: benefin = Balan; trifluralin = Treflan. Both were applied pre-plant incorporated.
3. Additional amounts of seeds of nicotiana, cosmos, and portulaca were recovered by vacuuming seeds that had fallen (shattered) to the ground. The recovered seeds amounted to 165, 1,000, and 108 pounds per acre, respectively.

a drying period. Soil particles adhering to the crowns and roots present a seedcleaning problem so investigation into the use of desiccants as harvest aids has been started in an attempt to make direct-combining possible. Alyssum has a moderately high shatter hazard.

2. Aster (*Aster novae-angliae*): Giant Crego Mix was seeded April 3, and, while it grew well, it did not bloom until after September 15. Frosts in September and October did not appear to damage the flowers and developing seeds. The late maturity of the seeds coupled with rain in October and early November delayed harvest, but the crop was direct-combined November 13 with a seed yield of 389 pounds per acre. Aster has good seed potential and a moderately low shatter hazard, but its late maturity can make harvest difficult because of unfavorable weather conditions.

3. Carnation (*Dianthus caryophyllus*): Chaubaud Giant Mix was seeded April 3 with bloom starting in early August and continuing into October. The flowers were not very attractive to honeybees. No seed harvest was made because of the large number of immature seeds.

4. Cosmos (*Cosmos bipinnatus*): Sensation Mixed was seeded May 1 and it grew vigorously. Seedset was heavy, but wind caused an estimated 85 percent seed loss at maturity. The crop was direct-combined September 8, although the plant material was still quite green, with a yield of 161 pounds per acre. Seed that had previously fallen to the ground was vacuumed from the plot area, with the yield of approximately 1,000 pounds per acre. Hummingbirds attracted to the plants probably were pollinating agents.

Cosmo appears to be well-adapted, tolerates herbicides well, is easy to establish, and has a high seed yield potential if it can be managed without excessive shattering. Swathing the crop slightly before full maturity should help minimize seed losses.

5. Dahlia (Dahlia rosea): Unwin's Dwarf Mix was seeded April 21 and produced a good stand, although a few plants were lost because of root rot. The crop was swathed October 7 and combined a few days later with the yield being 21 pounds per acre. The seed potential of dahlia does not warrant commercial production in Southern Oregon.

6. Dianthus (*Dianthus plumarius*): Double Gaiety Mixed was seeded April 3. Growth and vigor were satisfactory and the crop was direct-combined September 17 when most of the seeds were mature. The yield of seed was 233 pounds per acre. Dianthus could be grown commercially in Southern Oregon from an early spring seeding. It should be swathed before combining. It has a moderately low shatter hazard.

7. Dimorphotheca (*Dimorphotheca auriantiaca*): Auriantiaca Mixed was seeded April 3. Emergence

was the most rapid of the flower species with bloom starting by June 1. By July 10, some seeds were mature and shattering. The crop was cut and placed on a tarp with a seed yield of 238 pounds per acre. The plant matures seed over an extended period so that buds, flowers, immature and mature seeds are harvested at the same time. It grows well, tolerates herbicides well, and produces seed abundantly, but the shatter hazard is very high. Placing the swath on paper would prevent much of the seed loss.

8. Helichrysum (*Helichrysum bracteatum*): Double Dwarf Mix of strawflower was seeded April 3 and growth was vigorous with bloom starting about June 25. Hand harvest was necessary because the heads open at maturity and seeds become airborne if harvest is delayed. The first seed heads were picked July 31 and successive harvests were made at 3- to 7-day intervals during August and September. Frost did not appear to damage the blossoms and heads continued to form into November. The seed yield was 124 pounds per acre. Helichrysum is well-adapted for seed production in Southern Oregon and could become a family enterprise on a smaller farm, assuming hand labor is available during the harvest period.

9. Larkspur (*Delphinium ajacis*): Giant Imperial Mix was seeded April 3. Many plants were lost to root rot following irrigation. The remaining plants, estimated at less than 20 percent of a full stand, were cut September 10 and yielded 62 pounds of seed per acre. Larkspur probably should be seeded in the early fall and grown to maturity without irrigation.

10. Nicotiana (*Nicotiana sanderae*): Sensation Mixed was seeded April 21, grew well, and attracted a number of hummingbirds. The crop was hand-harvested September 24 and the heads were placed on a tarp. Seeds of nicotiana shatter readily and much of the seed was on the tarp at threshing time. The seed yield was 435 pounds per acre. A selected area near the center of the plot, swept with a vacuum cleaner, yielded an additional 165 pounds per acre. The crop is a good producer in Southern Oregon, but shatter losses can be great unless extra care, such as placing the swath on paper, is taken at harvest.

11. Ornamental Basil (*Ocimum basilicum*): Dark Opal was seeded May 1, grew well, and was very attractive to honeybees. The crop was swathed September 16 and combined September 22, yielding 747 pounds of seed per acre. It appears to be well-adapted for seed production in Southern Oregon. It has a low shatter hazard, but showed little tolerance to the herbicides used in the greenhouse trials except for a low rate of bensulide.

12. Pansy (*Viola tricolor*): Arcadia Mixed was seeded April 3. The first seed pods were hand-picked August 3. Several more harvests followed at irregular intervals. The seed was well-developed and of good quality but yields were not determined because of incomplete harvest. Pansy probably should be seeded in the early fall to encourage more growth and earlier maturity. The flower could be considered a family enterprise if hand labor were available, with seed harvested at regular intervals to minimize seed loss from shattering.

13. Petunia (*Petunia hybrida*): Happy Talk Mix was seeded April 3 and a good stand developed. Bloom extended over a long period with some flowers still in bloom when the crop was swathed and placed on tarps September 28. The seed yield was 263 pounds per acre. There was a small loss during swathing because of shattering. Petunia seems well-adapted in Southern Oregon but it must be handled carefully to prevent excessive seed loss and the seed generally needs drying after threshing. Bees were not attracted to the flowers but the sphinx moth, present in the evenings, was a factor in pollination.

14. Portulaca (*Portulaca grandifolia*): Double Mixed was seeded May 1 and required cultivation and handweeding because no herbicide was used. It grew well and the flowers were very attractive to honeybees. The crop was cut September 17 and placed on tarps to dry. Many seed capsules were on the ground and a number had broken open prior to harvest. Vacuum cleaners were used to pick up capsules and loose seeds from the ground. The seed recovered from the ground amounted to 108 pounds per acre. The plant material on the tarps had very succulent stems and never dried properly, and while not all the seed was recovered, the yield was 60 pounds per acre.

15. Snapdragon (*Antirrhinum majus*): Super Tetra Mixed was seeded April 3. The stand was thin because of root rot and the crop was reseeded May 23. Some seed was produced by the late seeding but no yield data were taken. Bumblebees were attracted to the flowers.

16. Stock (*Matthiola incana*): Dwarf Ten Weeks Mix and Giant Imperial Mix were seeded April 3. Both had excellent stands and grew vigorously. The Dwarf Ten Weeks Mix started bloom June 15. Giant Imperial Mix did not start bloom until early in July. The Dwarf Ten Weeks Mix was swathed September 24, proved to very resistant to shat-

tering, and yielded 261 pounds of seed per acre. Giant Imperial Mix failed to mature before unfavorable weather made harvest impractical. Stock appears to be well-adapted in Southern Oregon in the maturity range of Dwarf Ten Weeks Mix. Early spring or fall seeding might allow later maturing varieties to be harvested. Its resistance to shattering and its tolerance to herbicides make stock quite easy to manage, although with excessive irrigation or in poorly drained soil it is susceptible to root rot disease.

17. Zinnia (*Zinnia elegans*): Giant Double Mixed and Tetra Mixed were seeded May 1. Bloom started late in June and continued until frost on September 15. Both were direct-combined October 9 after later frosts had caused drying of leaves and heads. The yields were 115 pounds per acre for the Giant Double and 48 pounds per acre for the Tetra Mixed, both lower than anticipated. Zinnia can be grown commercially in Southern Oregon as indicated by subsequent trials and grower experience. It does require a long growing season but probably could be seeded as early as April 20 in the more frost-free areas. The seeds must be dried after combining because the crop is not swathed and dried prior to threshing. Bumblebees and other wild bees are more attracted to the flowers than are honeybees. Other plants in bloom at the same time draw some bees from the zinnia.

1971 RESULTS

Results for the individual flower species trials are presented in the following discussions. Summary data are presented in Table 3. Thirteen flower species tolerant of spring frosts were seeded March 19 and 20, and 7 species were seeded May 7 after danger of frost was past. Carnation, centaurea, eschscholtzia, iberis, larkspur, lupine, pansy, snapdragon, stock, and sweet william were seeded November 16 ,1970, but all winter-killed except iberis.

1. Ageratum (*Ageratum houstonianum*): Blue Mink, the variety seeded, reached a height of 10 inches. It was mowed and placed on a tarp September 9. The yield of seed was 76 pounds per acre. The crop seems adapted to production in Southern Oregon. The plant has a high shatter hazard, especially if it is necessary to undercut or swath the crop rather than direct-combine it.

2. Alyssum: Royal Carpet variety was grown again in 1971 with less honeybee activity observed and a lower seed yield than in 1970.

3. Balsam (*Balsamina impatiens*): Tall Camellia Flowered Mix was grown and was cut and placed on tarps September 23. The stems were large, very succulent, and required considerable drying. The seed yield was 444 pounds per acre. Balsam has a moderately high shatter hazard since the

Table 3. Summary of flower seed cultural and yield data, Southern Oregon Experiment Station, Medford, 1971

Flower Species	Seeding Date	Planter Plate Hole Setting[1]	Herbicide Used,[2] (Pounds/acre)	Harvest Date	Cutting Method	Shatter Hazard	Seed Yield, (Pounds/acre)
Ageratum	Mar. 19	2	trifluralin 0.75	Sept. 9	swathed	high	76
Alyssum	Mar. 19	2	trifluralin 0.75	Oct. 4	undercut	moderately high	23
Balsam	May 7	10	trifluralin 0.75	Sept. 23	swathed	moderately high	444
Candytuft	Mar. 19	7	trifluralin 0.75	Sept. 2	combined	moderate	390
Calendula	Mar. 19	22	trifluralin 0.75	Aug. 12	swathed	moderately low	272
Carnation							
Chaubaud	Mar. 20	9	nitrofen 4.0	Oct. 4	swathed	moderate	99
Dw. Fragrance	Mar. 20	9	nitrofen 4.0	Oct. 4	swathed	moderate	162
Celosia	June 4	3	none	Oct. 14	swathed	moderate	318
Centaurea	Mar. 20	12	benefin 1.25	Aug. 19	swathed	low	736
Cleome	May 7	6	bensulide 6.0	Sept. 17	hand clip	high	219
Eschscholtzia							
Extra Golden	Mar. 20	2	benefin 1.25	July 27	swathed	very high	379
Mission Bells	Mar. 20	2	benefin 1.25	Aug. 3	swathed	high	120
Gaillardia	Mar. 19	14	trifluralin 0.75	Oct. 4	swathed	moderately low	99
Gypsophila	Mar. 19	3	EPTC 2.5	July 27	swathed	moderately high	514
Hollyhock	Mar. 19	31	trifluralin 0.75	Sept. 9	hand clip	high	1,577
Iberis	Nov. 16	12	nitrofen 4.0	did not flower during the season			
Marigold	May 7	30	triflura'in 0.75	Oct. 29	combined	moderately low	180
Myosotis	Mar. 20	2	nitrofen 4.0	Aug. 3	swathed	moderately high	low
Salvia	May 7	10	benefin 1.25	Oct. 29	combined	moderate	low
Sweet William	Mar. 20	6	nitrofen 4.0	did not flower during the season			
Verbena	Mar. 19	14	trifluralin 0.75	Oct. 14	swathed	moderately low	146
Vinca	May 7	5	paraquat 0.50	failed to mature seeds before frost			
Zinnia	May 7	34	benefin 1.25	Oct. 29	combined	moderate	143

1. Planter plate hole setting is for a Planet Jr. type seeder used in the trials.
2. Trifluralin (Treflan), benefin (Balan), bensulide (Prefar), and EPTC (Eptam) were applied pre-plant incorporated; nitrogen (TOK) was applied pre-emergence to the carnation, sweet william, and post-emergence to the iberis. Paraquat was applied pre-emergence to the vinca.

seed capsules snap open easily at maturity. It does have commercial possibilities in Southern Oregon provided it can be dried sufficiently after swathing.

4. Candytuft (*Iberis umbellata*): Dwarf Fairy Mixed was grown, reaching a height of 16 inches. It was direct-combined September 2 with a seed yield of 390 pounds per acre. It is very tolerant of several herbicides, matures relatively early, and could be grown commercially in Southern Oregon.

5. Calendula (*Calendula officinalis*): Pacific Beauty Mixed was grown and it reached a height of 30 inches. It was swathed August 12 with a seed yield of 272 pounds per acre. It has a moderately low shatter hazard and could be grown commercially in the area. It matures when crop drying conditions are still favorable.

6. Carnation: Chaubaud Giant Mixed and Dwarf Fragrance Mixed were seeded March 19 and received a pre-emergence application of nitrofen at 4.0 pounds per acre. Both were swathed October 4 with the Chaubaud Giant Mixed yielding 99 and the Dwarf Fragrance yielding 162 pounds of seed per acre. Carnation has a moderate shatter hazard, using the swathing and combining method of harvest. Because it has a fairly good yield potential from early spring seeding, it is moderately well-adapted for seed production in Southern Oregon.

7. Celosia (*Celosia plumosa*): Tall Pampas Plume Mixed was reseeded June 4 because of intense weed competition in the May 7 planting. The crop attained a height of 48 inches, was cut and placed on tarps October 14, and yielded 318 pounds of seed per acre. Celosia had poor tolerance to the test herbicides in the greenhouse but could be grown in weedfree fields. It has a moderate shatter hazard.

8. Centaurea (*Centaurea cyanus*): Cyanus Double Mixed bachelor button yielded 736 pounds of seed per acre after being swathed August 19. It yields well, has a low shatter potential, has tolerance to several herbicides, matures while drying conditions are favorable, and is adapted for seed production in the Southern Oregon area.

9. Cleome (*Cleome spinosa*): Giant Pink Queen was grown in soil treated with 6.0 pounds of bensulide per acre. It was harvested September 17 by hand-clipping the heads and putting them on tarps to dry. The seed yield was 219 pounds per acre. Cleome, or spiderflower, has a high shatter hazard since the slender pods pop open easily at maturity. It could be grown commercially in the area, but swaths should be laid on paper to help avoid seed loss.

10. Eschscholtzia (*Eschscholtzia californica*): Extra Golden and Mission Bells varieties were grown. Bloom was relatively early and the flowers were very attractive to honeybees and bumblebees. Extra Golden was cut July 27 and Mission Bells was cut August 3. Both were placed on tarps since the seed shatters readily from the slender pods. The yields of seed were 379 and 120 pounds per acre, respectively.

11. Gaillardia (*Picta lorenziana*): Double Gaiety Mixed was grown, with the crop swathed October 4. The growth was excellent, but the seed yield was relatively low at 99 pounds per acre. The shatter hazard of the crop is moderately low and it tolerates herbicides well.

12. Gypsophila (*Gypsophila paniculata*): Covent Garden White was grown in soil treated with EPTC (Eptam) at 2.5 pounds per acre. It flowered early in the season and was cut and placed on tarps July 27. The seed yield was 514 pounds per acre. It has a moderately high shatter hazard but yields well and is a commercial possibility in the Southern Oregon area.

13. Hollyhock (*Althaea rosea*): Annual Madcap Mixed flowered well and was attractive to bees and hummingbirds. It was cut and placed on tarps September 9 with the yield of seed being 1,577 pounds per acre. The shatter hazard with hollyhock is quite high, but seed loss could be reduced by swathing the crop and placing it on paper.

14. Iberis (*Iberis sempervirens*): It was seeded November 16, 1970, survived the winter and grew well but failed to flower in 1971.

15. Marigold (*Tagetes patula*): Dwarf French Petite Yellow had an excellent stand and a heavy bloom. It was not attractive to honeybees and bumblebees but sweatbees were seen on the flowers. It was late in maturity and despite many blank, undeveloped seeds the yield of seed was 180 pounds per acre when it was direct-combined October 29. It has possibilities as a commercial crop in the area although it matures late in the season when unfavorable weather can cause harvest difficulty.

16. Myosotis (*Myosotis oblongata*): The Blue Bird variety had a good stand with satisfactory growth. Because of its low seed yield potential, it does not appear to be adapted for commercial production in the Southern Oregon area.

17. Salvia (*Salvia splendens*): Early Bonfire and St. John's Fire varieties were grown but the seed yields were low. Salvia does not appear to be adapted for seed production in the Southern Oregon area.

18. Sweet William (*Dianthus barbatus*): Dwarf Double Mixed was seeded March 20, grew vigorously, but failed to flower in 1971.

19. Verbena (*Verbena hybrida*): Ideal Florist Mixed grew well and was cut October 14 and placed on tarps. The seed yield was 146 pounds per acre. The crop could be grown for seed production in the Southern Oregon area, although it matures rather late in the season. It is only moderately attractive to honeybees but the sphinx moth is active as a pollinating agent during the evening.

20. Vinca (*Vinca rosea*): Tall Mixed variety grew well and bloomed in September but the seeds were not mature at the time of the first killing frost October 16 so it was not harvested. Vinca requires a longer growing season than the Southern Oregon season.

21. Zinnia: Giant Double yielded at a rate of 143 pounds of seed per acre. Zinnia is well-adapted for seed production in the Southern Oregon area.

22. Geranium (*Pelargonium domesticum*): The only flower species in the trials that was not started in the field from seeds were two varieties of geranium set out as plants August 2. The objective was to determine if they had sufficient cold hardiness to survive the winter and produce seed in 1972. Both geraniums were killed when the temperature dropped to 25 degrees Fahrenheit October 17.

1972 RESULTS

Field plot trials were designed to provide information on fall seeding and overwintering of several flower species. Calendula, carnation, centaurea, delphinium, dianthus, eschscholtzia, iberis, iceland poppy, larkspur, myosotis, pansy, shirley poppy, stock, and sweet william were seeded October 6, 1971. While emergence of the flower species were satisfactory, freezing and thawing during the winter caused most of the plants to be heaved out of the ground. Only centaurea, iceland poppy, and shirley poppy emerged from the winter with good stands. Results for the individual flowers are presented in the following discussions. Table 4 summarizes cultural and yield data for the flower species.

1. Centaurea: Cyanus Double Mixed was seeded October 6, 1971, swathed August 2, 1972, and yielded 693 pounds of seed per acre. It is adapted to fall and spring seeding in Southern Oregon, has a low shatter potential, good herbicide tolerance, and is relatively easy to handle in seed production.

2. Iberis: Seeded in November, 1970, it failed to bloom in 1971 but reached full bloom in March and April, 1972. It was swathed July 7 and dried without using a tarp. The seed yield was 94 pounds per acre. The shatter potential of the crop is moderate. To be grown commercially in the area, iberis would have to be seeded in the spring or summer to allow sufficient development for seed formation the following year.

3. Iceland Poppy (*Papaver nudicaule*): Champagne Bubbles was seeded October 6, survived the winter, and was hand-harvested July 7. The yield was low, partly because of competition from winter-annual weeds. No herbicides were used since the iceland poppy had shown little tolerance to herbicides in the greenhouse trials. The shatter potential of the plant is high although direct-combining might be possible and would eliminate seed losses from swathing.

4. Shirley Poppy (*Papaver rhoeas*): Shirley Double Mixed was seeded October 6 without the use of a herbicide since it showed little tolerance to herbicides in the greenhouse trials. It was a vigorous grower and competed strongly against winter-

Table 4. Summary of flower seed cultural and yield data, Southern Oregon Experiment Station, Medford, 1972

Flower Species	Seeding Date	Planter Plate Hole Setting[2]	Herbicide Used,[3] (Pounds/acre)	Harvest Date	Cutting Method	Shatter Hazard	Seed Yield, (Pounds/acre)
Centaurea	Oct. 6	12	trifluralin 0.75	Aug. 2	swathed	low	693
Iberis	Nov. 16[1]	12	nitrofen 4.0	July 7	swathed	moderate	94
Iceland Poppy	Oct. 6	45	none	July 7	hand clip	high	low
Shirley Poppy	Oct. 6	43	none	July 7	swathed	moderately high	426
Sweet William	Mar. 20[1]	6	nitrofen 4.0	July 7	swathed	moderate	267

1. Iberis was seeded November 17, 1970, but failed to flower in 1971; sweet william was seeded March 20, 1971, but failed to flower in 1971.
2. Planter plate hole setting refers to the setting used for the Planet Jr. seeder used in the trials.
3. Trifluralin (Treflan) was applied pre-plant incorporated; nitrofen (TOK) was applied post-emergence.

annual weeds. It was swathed and placed on tarps July 7 and the seed yield was 426 pounds per acre. The shirley poppy has a moderately high shatter potential but is adapted for seed production in the Southern Oregon area.

5. Sweet William (*Dianthus barbatus*): Double Mixed was seeded March 20, 1971, and although it had excellent growth it failed to flower that year. It over-wintered, bloomed, set seed, and was swathed July 7, 1972. The seed yield was 267 pounds per acre. It appears to be adapted for seed production in the area, but it would have to be seeded in the early fall to set seed the following year.

BEES AND OTHER POLLINATING AGENTS

Alyssum, eschscholtzia (California poppy), ornamental basil, and portulaca attracted large numbers of honeybees, while carnation, petunia, verbena, and zinnia were not highly attractive to honeybees. Bumblebees (Bombus sp.) were attracted to snapdragons and zinnia. Marigold attracted more sweatbees (Halictus sp.) than honeybees. Most of the other flower species were considered intermediate in attractiveness to honeybees and wild bees.

Other pollinating agents observed were hummingbirds on cosmos and hollyhock and the sphinx moth on petunia and verbena. Wind assisted in the pollination of a number of the flower species.

Part III: Adaptability Ratings

Based on results from three years of field trials, the flower species can be classified into three groups according to apparent adaptabilities for commercial seed production in Southern Oregon. Brief descriptions of the groups are given below. The adaptability classifications are in Table 5.

Group I flower species are considered well-adapted for commercial seed production because they are relatively easy to establish, have good tolerance to hebicides, mature in proper season, have low to moderate shatter potential, and yield well. They usually can be grown using the same types of equipment used in production of other area seed crops.

Group II flower species, moderately well-adapted, are somewhat more difficult to manage, or their yield potentials are judged too low for Group I. Some are in Group II because they have little or no tolerance to herbicides, increasing the need for cultivation and costly handweeding; some may have a high shatter potential against which special precautions must be taken; some may be late in maturity and present harvest and crop drying problems, or some may be quite susceptible to root disease.

Group III flower species, not adapted for seed production in Southern Oregon, are in the group for one or more reasons. These may include low

Table 5. Adaptabilities of flower species for commercial seed production in the Southern Oregon area with reasons for classification into Groups II or III

GROUP I, WELL-ADAPTED	GROUP II, MODERATELY WELL-ADAPTED		GROUP III, NOT ADAPTED
Calendula	*Moderate Yield*	*High Shatter Potential*	*Low Yield Potential*
Candytuft	Carnation	Ageratum	Alyssum
Centaurea	Gaillardia	Balsam	Dahlia
Dianthus	Iberis	Cleome	Iceland Poppy
Zinnia	Sweet William	Cosmos	Myosotis
		Dimorphotheca	Salvia
	Little Tolerance to Herbicides	Eschscholtzia	
		Gypsophila	*Root Diseases*
	Celosia	Helichrysum	Larkspur
	Ornamental Basil	Hollyhock	Snapdragon
	Shirley Poppy	Nicotiana	
		Pansy	*Harvest or Processing Difficulty*
	Late Maturity	Shirley Poppy	Alyssum
	Aster	Petunia	Portulaca
	Marigold		
	Petunia		*Too Late in Maturity*
	Verbena		Vinca
	Root Diseases		*Not Winterhardy*
	Stock		Geranium

yield potential, harvesting, and seed processing difficulties, susceptibility to disease, lateness of maturity, or insufficient winter-hardiness. Further research could result in moving some of the flower species into the two higher groups.

An additional important factor in considering the adaptability of a flower seed crop is the price per pound being offered the prospective grower. Because seed prices can change from year to year, they have not been discussed in this publication. They should be considered, however, in relation to expected yields and costs of production before a decision is made whether to grow a flower seed crop or an alternative crop.