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Assessment of height, earliness and biomass production in selected winter flowering ornamental annuals for better utilization in landscaping

Bikash Bhattarai, Soumen Maitra and Rocky Thokchom

Abstract
An experiment was conducted to evaluate twenty different species of winter flowering ornamental annuals mostly used for landscaping purpose under different agro-climatic conditions in the Terai region of West Bengal, India, in respect of plant height, leaf chlorophyll content, earliness in flowering and biomass production both under open-field and polyhouse condition. The plant height at 15 days interval starting from 30 days after transplanting (DAT) was found greater in polyhouse condition than open-field cultivation. Petunia showed the maximum plant height (133.99cm) under polyhouse and minimum plant height was recorded in Daisy (26.08cm) at 75 DAT under open-field condition. Earliness in flower bud initiation (23.25DAT) was observed with *Calendula officinalis* under open-field condition and the delayed flowering was observed with *Antirrhinum majus* (74.67DAT) under protected condition. Candytuft took minimum time period to reach FBD from FBI (6.17days). Lupin required minimum time to bloom from FBD (1.50days) under polyhouse condition, whereas maximum time period requirement from blooming to wilting was observed in Helichrysum (21. 84days) in open-field condition. Maximum leaf chlorophyll content was found in Dimorphotheca (64.30 SPAD value) under open-field condition. Root: Shoot ratio on fresh weight basis was found higher in Phlox (0.523) under polyhouse and minimum was recorded from Ice Plant under open-field condition (0.016). Maximum and minimum Root: Shoot ratio on dry weight basis was obtained from Sweet Pea (0.335) and Ice Plant (0.019) respectively under open-field condition. Minimum shoot length was observed in Daisy (26.75cm) under both conditions and maximum was obtained from Antirrhinum (132.50cm) under polyhouse. Maximum and minimum root lengths were recorded with Calendula (28.25cm) under open-field condition and Sweet Pea (6.35cm) under polyhouse respectively. The present experiment gave the precise database of the comparative performance of twenty different winter annuals in respects of plant height, biomass production and the duration between the major stages of flowering from the preceding stage.

Keywords: Plant height, winter annuals, *Antirrhinum, Calendula, Helichrysum, Petunia*

Introduction

Ornamental annuals complete their life cycle within one growing season of the year having short period of lifespan. Annuals are an important group of flowering plants widely used for garden decoration, potted plants and cut-flowers. They have huge number of species and many varieties which not only show variations in height and growth habit but also in the shape, size and colour of flowers. Winter flowering ornamental annuals serve as important components in any landscape plan (Brown, 2012) [4] and also used as bedding plants, garden plants, plants for rockery, window basket, cut flowers and herbaceous border in gardens (Stevens and Gast, 1992) [31]; (Love *et al*., 2009) [22].

In any landscape design plant height of winter flowering ornamental annuals plays a crucial factor for displaying in a proper way (Howe and Waters, 1988). Height of plants offers landscaper to utilize the winter annuals as per the garden design or to create visually appealing borders and shrubberies. Generally, winter annuals are recognized as tall, medium and dwarf types for the use in landscape design. Plant height during growing periods interlinked with the biomass production and leaf cholorophyll as well as earliness in flowers. The relationships of crop yield and plant biomass with plant height need to be adequately evaluated under cropping systems and production conditions. Fertilizer accumulation is highly variable and dependent upon environment and management strategy of the plants during growing stage and the production of yield (Balkcom and Reeves, 2005; Cherr *et al.* 2006; Yin *et al.* 2012) [2, 5, 39]. Winter annuals produce substantial biomass in a short period of time, and could enhance aboveground biomass production and improve associated cover crop benefits, while reducing

producer input costs. Flowering is another physiological process which relies mainly on temperatures, light and growing conditions. Flowering of many herbaceous annual ornamentals was reduced or eliminated under high temperature regimes (Warner and Erwin, 2005) [36] whereas, light energy is also used extensively in the most basic metabolic process of plant i.e. photosynthesis, however, the response of flowering of many plants depends on the duration, intensity and quality of light (Murchie *et al.* 2002) [26]. According to the basis of light duration plants are divided as: long day plants, short day plants and day neutral plants (Thomas and Vince, 1984; Thomas and Vince, 1997) [32, 33]. During winter, low light integrals causes slow growth and development which is a limiting factor in many long day annuals for early flower production. Flowering time and node number below the first flower decreased with increase in daily light integrals was reported during crop production, whereas increase in dry weight gain and flower number in many bedding plant species was observed (Faust *et al*., 2005; Mattson and Erwin, 2005; Warner and Erwin, 2006) [36, 37]. In *Antirrhinum*, the flowering time and leaf numbers significantly decreased with increase in light intensity (Flint, 1960; Cremer *et al.*, 1998) [11, 6]. The effects of varying temperature on the flowering time and plant quality has been observed on growth and flowering in *Antirrhinum majus* (Munir *et al*., 2004) [25]. In flowering annuals, the planting time greatly influences the acceptable quality and seed yield (Gupta *et al*., 1995). Munir *et al* (2004) [25]; Bie *et al.* (2008) [3] studied that plant height, leaf area and plant fresh weight of winter annual, were improved under shading treatments.

More studies are required to assess more precisely for the use of ornamental annuals for garden decoration. Although data on plant height, and biomass production are available in the literature, but data regarding the same for all the winter annuals ornamental species are not available, particularly for Terai region of West Bengal conditions. Our main aim were to determine the plant height, leaf chlorophyll content, earliness in flowering and biomass production of twenty different winter annuals both under open-field and polyhouse condition. The main objective of this work is to provide the use of ornamental annuals in landscape and garden display as well as in commercial floriculture of the Terai region of West Bengal.

Materials and Methods

The experiment was carried out at the instructional field of Department of Floriculture, Medicinal and Aromatic plants, Faculty of Horticulture, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal, India, following Randomized Block Design with 20 different winter flowering ornamental annuals replicated twice. The detail of the species is presented below (Table - 1). Seeds of 20 winter flowering ornamental annuals were sown on October 2012 in seed beds having a dimension of 3m x 1m with a height upto 15 cm from the ground level. 10 g seeds of each winter annual (total 200g) were sown. Five such seed beds were prepared to sow the seeds of 20 different species. 5 kg well rotten FYM along with 10 g each of N_2, P_2O_5 and K_2O / m^2 was applied initially. Copper oxychloride @ 2 g/litre of water was sprayed twice at 10 and 20 days age of seedling as preventive measure.

Table 1: The details of the winter flowering ornamental annual species used

Sl. No.	English common name	Botanical name	Plant family
1	Snapdragon	*Antirrhinum majus* L.	Scrophulariaceae
2	Pot Marigold / Calendula	*Calendula officinalis* L.	Compositae
3	Straw Flower / Helichrysum	*Helichrysum bracteatum* (Vent.) Andrews	Compositae
4	Petunia	*Petunia hybrida* Vilm	Solanaceae
5	Livingstone Daisy / Mesembryanthemum	*Mesembryanthemum criniflorum* L.	Aizoaceae
6	Larkspur	*Delphinium ajacis* L.	Ranunculaceae
7	Daisy / English Daisy	*Bellis perennis* L.	Compositae
8	Californian Poppy	*Eschscholtzia californica* Cham.	Papaveraceae
9	Shirley Poppy	*Papaver rhoeas* L.	Papaveraceae
10	Lupin	*Lupinus hartwegii* L.	Leguminosae
11	Sweet Pea	*Lathyrus odoratus* L.	Leguminosae
12	Brachycome / Swan River Daisy	*Brachycome iberidifolia* Benth.	Compositae
13	Dimorphotheca / African Daisy / Cape Marigold	*Dimorphotheca aurantiaca* DC.	Compositae
14	Phlox	*Phlox drummondii* Hook.	Polemoniaceae
15	Sweet William	*Dianthus barbatus* L.	Caryophyllaceae
16	Coreopsis / Calliopsis / Tick-seed	*Coreopsis tinctoria* L.	Compositae
17	Dianthus / Common Pink	*Dianthus chinensis* L.	Caryophyllaceae
18	Candytuft	*Iberis umbellata* L.	Cruciferae
19	Cornflower	*Centaurea cyanus* L.	Compositae
20	Pansy	*Viola tricolor* L.	Violaceae

28 days old seedlings were transplanted in the main field with spacing varies with the genotypes (Table - 2). Land was brought to fine tilth by repeated ploughing. Plot size was maintained at 1.0 m × 1.0 m. Each plot was separated to the other through a 30 cm wide path in both ways. Similarly in the polyhouses 40 such beds were prepared. The nutrients were applied in the form of urea, SSP and MOP as a source of N, P and K respectively. Well rotten (5Kg) FYM along with N_2 (6 g/plot in the form of urea at 13.2 g/plot), P_2O_5 (8 g/plot in the form of SSP at 50 g/plot) and K_2O (8 g/plot in the form of MOP at 13.6 g/plot) as basal per bed. The bulky organic manure and the fertilizers were mixed thoroughly in the soil during the final stage of land preparation and leveling. A similar dose of nitrogen was applied after 30 days of transplanting as top dressing. Twenty different winter annuals were planted in same manner in open-field as well as in polyhouse condition. GI pipe-frame polyhouse having 200 gauge UV-stabilized polyethylene sheet as cladding material and sides covered with insect-proof white nets with side-vents open facility was used for the experiment.

Table 2: Spacing of the selected Genotypes

Spacing	Genotypes
25cm × 25cm	Daisy, Phlox, Dianthus, Californian Poppy, Petunia, Shirley Poppy, Coreopsis, Sweet William, Pansy, Candytuft
30cm × 30 cm	Brachycome, Ice Plant, Antirrhinum, Lupin, Cornflower, Larkspur, Helichrysum
50cm × 30 cm	Calendula, Dimorphotheca, Sweet Pea

Parameters such as plant height at 15 days interval, Root-Shoot ratio, Weight of 10 flowers/plant, Days required for flower bud initiation (FBI), Days required for flower bud development (FBD), Days required for blooming, Days required for wilting of flower were recorded in each plot and their average was calculated. Data were analyzed using GLM procedure of Statistical System (SAS) Software (Version 9.3).

Results and Discussion

The genotypes differed significantly in respect of plant height at 15 days interval after 30 DAT. The minimum plant height was observed in Daisy (7.64 cm) under open-field condition whereas; under polyhouse Brachycome (8.07 cm) showed the minimum. Maximum plant height among the rest of all was observed in Corn flower (29.90 cm) which was statistically at par with Helichrysum (25.57 cm) under open field and Cornflower (46.87 cm) followed by Sweet Pea (33.84) was recorded under polyhouse at 30 DAT. After attaining certain height under open-field and polyhouse conditions plant heights at 45 DAT, 60 DAT and 75 DAT were successively recorded (table-5). Lowest plant height at 75 DAT was recorded in Daisy (26.08 cm), moderate height was recorded in Phlox (50.74 cm) and highest height was recorded in Helichrysum (99.74 cm) followed by Cornflower (98.62 cm) under open-field. Lowest plant height among the genotypes under polyhouse was found in Daisy (32.20 cm), medium height was found in Dianthus (70.00 cm) and highest plant height was recorded in Petunia (133.99 cm) which was statistically at par with Helichrysum (133.30 cm). Plant height was checked at every 15 days interval and received a marked difference within the genotypes under both open-field and protected situation as well as in the same genotype. Results revealed that the plant height at 75 DAT showed higher in the polyhouse than the open field culture in all the species but the difference did not follow a general trend like the difference in Daisy was 26.08 -32.20 cm whereas in Dimorphotheca the same was found as 56.67 – 108.12 cm indicated the sunny and shade loving plant species within the group. Runkle *et al.* (2002) [28]; Bie *et al*. (2008) [3]; Ito *et al.* (1997) [15] and Munir *et al*. (2004) [25] also observed differences in plant height within a population of ornamental annual plant species namely Pansy and 10 other annuals; Petunia; Calendula; *Matthiola incana, Antirrhinum majus, Viola x wittrockiana*, *Impatiens walleriana* and *Antirrhinum majus* repectively. For many plants, height is significantly decreased as day temperature relative to the night temperature decreases which is also observed by Erwin *et al.* (1991) [10] and Erwin and Heins (1990) [9]. Love *et al*. (2009) [22] also reported the importance of plant height, altitude, temperature, growing season and light intensity to use the ornamental annuals in landscaping.

Twenty different winter flowering ornamental annuals were grown under open-field and protected condition. Results revealed that the flowering commenced earlier in open-field and later in polyhouse situation. Among the twenty crops - Calendula reached the flower bud initiation stage earliest (23.25 DAT) under open-field cultivation, whereas, delayed flowering was observed in Antirrhinum (74.67 DAT) under polyhouse situation.

In respect of earliness in flower bud development after attaining flower bud initiation, the minimum time period taken to reach FBD from FBI was observed in candytuft (6.17 days), blooming from FBD in Lupin (1.50 days) and blooming to wilting of flowers was recorded in Californian poppy (2.00 days) under polyhouse condition, whereas maximum from FBI to FBD was noticed in Cornflower (19.60 days) under open-field condition, from FBD to blooming in Helichrysum (6.57 days) under polyhouse and from blooming to wilting in Helichrysum (21. 84 days) in open-field condition. Blooming period in both open-field and polyhouse condition was significantly differed (table-3). Weight of 10 flowers was found higher in open-field culture of Helichrysum (44.40 g), whereas minimum was observed under polyhouse condition in Phlox (0.37g). Chlorophyll was measured by using SPAD meter and was expressed in SPAD value and data is presented in table-3. Maximum leaf chlorophyll content was found in Dimorphotheca (64.30) and minimum in Larkspur (14.90) under open-field. In any landscaping situation simultaneous blooming is an essential principle to exert its best effect along with colour combination (Lindgren *et al.*, 2007 and Love *et al.*, 2009) [21, 22]. To achieve this objective it is essential to categorize the plants accordingly. The present experiment gave the precise database of the comparative performance of twenty different winter annuals in respects of the duration between the major stages of flowering from the preceding stage. This information would become helpful for the growers to sow the late bloomers well ahead with a quantitative measurement. The variation in different durations species-wise might be due to a combination of several factors like environmental stimuli, inherent growth pattern, soil condition, genotypic configuration of the species etc. The effect of temperature under different growing condition during flowering period was observed by Niu *et al*. (2000) [27]; Kang and Iersel, (2001) [17] and Warner (2010) [34]. Fluctuation of flowering behaviour under open and protected condition was observed due to temperature and light quality. This finding was conformed the observations of Kumar and Kaur (2000) [20] and Warner and Erwin (2002) [35], also noticed significant variation in FBI and other phases of flower development within the different ornamental annual species.

Maximum Root: Shoot ratio on fresh weight basis was found in Phlox (0.523) under polyhosue and minimum was recorded from open-field condition in Ice Plant (0.016). Maximum and minimum Root: Shoot ratio on dry weight basis was obtained from Sweet Pea (0.335) and Ice Plant (0.019) respectively under open-field condition. Minimum shoot length was observed in Daisy (26.75 cm) under both conditions and maximum was obtained from Antirrhinum under polyhouse (132.50 cm). In respect of root length, maximum was recorded under open-field condition in Calendula (28.25 cm) and minimum under polyhouse in Sweet Pea (6.35 cm). Though the trees and shrubs form the backbone of any landscape, the annuals add variety, accent and beauty to break the monotony that creates the difference between the routine and the spectacular (Love *et al*., 2009) [22]. In the present

experiment twenty different ornamental winter annuals were evaluated under two different growing environments. Result reveals that variability exists within the genotypes under each growing environment or in the same genotype under different growing conditions. The plants differed in their herbage and root biomass production which was expressed in terms of weight. This difference might be due to the variation in size of seeds of different species contained higher and lower amount of stored food material helped to establish and grow better in early stage or showed markedly less vegetative growth. Adams *et al.* (2003) [1]; Wu (2007) [38] and Dhatt and kumar (2010) [8] also reported variation in seedling growth in winter flowering annuals when evaluated under open field / protected condition. The probability value indicated that the winter annuals were not significantly different performers in those respects at > 5% level under polyhouse condition unlike the open-field situation; data is presented in (table- 4). Maximum root: shoot ratio on fresh weight basis under polyhouse condition was observed in Phlox (0.523) and minimum ratio was recorded in Dimorphotheca (0.024) followed by Antirrhinum (0.027). Maximum root: shoot ratio on dry weight basis was found in Coreopsis (0.254) followed by Sweet Pea (0.208). Minimum ratio was obtained in Antirrhinum (0.040) and Brachycome (0.041). In polyhouse condition maximum shoot length was recorded in Antirrhinum (132.50 cm) and minimum was recorded from Daisy (26.75 cm) followed by Brachycome (67.60 cm). Maximum root length in polyhouse condition was achieved in Helichrysum (16.25 cm) and minimum length was recorded in Sweet Pea (6.35 cm) followed by Larkspur and Lupin (7.25 cm).

Conclusion

Variability exists within the genotype as well as in the growing environment in respect of growth characters, leaf chlorophyll content, earliness, duration of blooming and weight of flowers. The grouping of annuals in respect of plant height and other flowering parameters would become also useful to select the relative placement of ornamental annuals in several garden components, herbaceous borders and in-campus or in outdoor landscaping. Some plants are found dwarf (Daisy, Brachycome, Candytuft, Pansy and Phlox) and need to be used for carpet bedding whereas taller genotypes (Helichrysum, Cornflower, Sweet Pea and Lupin) may be utilized in flower beds or backgrounds in landscaping. Earliness in flowering was successfully recorded, as per the results we can use different winter annuals in landscaping for proper display time. It was also confirmed that annuals grown under polyhouse conditions provides more plant biomass than open field, root: shoot ratio and shoot length was also found higher under polyhouse. In any landscaping situation, especially in herbaceous borders - simultaneous blooming is an essential principle to exert its best effect along with colour combination. To achieve this objective it is essential to categorize the plants accordingly. The present experiment gave the precise database of the comparative performance of twenty different winter annuals in respects of the duration between the major stages of flowering from the preceding stage. This information would become helpful for the growers to sow the late bloomers well ahead with a quantitative measurement.

Table 3: Earliness, leaf chlorophyll content and weight of flowers of winter annuals under open field and polyhouse condition

Genotypes	Open field						Polyhouse					
	Days required for FBI (DAT)	FBI-FBD (Days)	FBD – Blooming (Days)	Blooming – Wilting (Days)	Weight of 10 flowers (g)	Leaf Chlorophyll content (SPAD value)	Days required for FBI (DAT)	FBI – FBD (Days)	FBD – Blooming (Days)	Blooming – Wilting (Days)	Weight of 10 flowers (g)	Leaf Chlorophyll content (SPAD value)
Daisy	40.00	6.70	2.20	9.50	3.32	46.75	60.88	8.00	3.75	7.38	2.47	44.20
Phlox	43.80	9.70	2.30	3.50	0.37	21.45	54.30	10.80	2.70	3.20	0.33	29.65
Ice Plant	39.34	11.15	4.00	11.25	4.12	29.25	62.84	11.67	2.67	10.67	2.80	29.85
Helichrysum	38.67	16.33	5.34	21.84	44.40	46.55	53.84	15.27	6.57	18.64	37.31	45.35
Larkspur	48.75	16.13	2.25	12.63	0.76	14.90	55.17	16.00	2.51	10.67	0.75	17.45
Antirrhinum	47.00	10.75	3.34	6.83	4.45	39.45	74.67	11.51	2.83	4.17	3.81	31.90
Calendula	23.25	9.63	2.63	7.50	13.89	32.15	29.34	10.33	2.51	7.17	9.06	32.30
Sweet William	42.34	11.82	2.34	6.17	0.80	41.40	40.00	10.00	2.50	8.17	0.74	34.35
Petunia	47.70	7.80	2.00	3.90	3.70	43.75	67.00	8.13	2.38	5.75	3.14	33.35
Lupin	51.03	8.40	2.08	4.48	1.44	44.75	36.75	8.00	1.50	6.25	1.23	32.50
Brachycome	45.25	10.50	2.58	4.59	1.61	24.50	62.25	8.25	2.50	4.25	1.17	39.10
Cornflower	30.82	19.60	2.55	7.34	4.46	51.15	49.25	16.63	2.63	7.00	3.94	46.40
Dimorphotheca	40.60	14.60	2.80	7.80	10.55	64.30	59.00	8.92	3.30	8.63	9.89	39.05
Dianthus	45.63	10.25	2.50	6.13	0.71	25.95	48.88	9.63	3.00	8.00	3.12	44.35
Californian Poppy	45.67	8.09	2.09	3.17	4.86	26.50	65.75	9.25	2.00	2.00	3.53	16.75
Shirley Poppy	44.38	11.00	1.75	2.63	5.50	35.05	52.17	11.15	1.84	2.83	4.44	38.05
Pansy	26.23	7.93	2.20	9.78	2.25	33.40	56.94	8.17	2.37	9.30	2.79	48.00
Candytuft	31.50	7.84	1.84	7.17	0.48	27.45	34.34	6.17	1.67	7.84	0.37	30.40
Coreopsis	34.46	16.63	2.17	7.34	10.47	34.65	44.45	19.28	1.63	6.95	9.38	40.00
Sweet Pea	37.17	9.67	2.67	6.67	3.00	46.30	38.25	8.75	2.50	9.25	2.53	47.90
Pr>F	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	0.2317
CD	3.7712	3.4989	0.72	4.4485	2.4084	10.463	7.4436	3.2667	0.8822	2.9874	1.9136	22.419

Table 4: Root: Shoot ratio on Fresh and dry weight basis and root and shoot length of winter annuals at the end of season under open field and polyhouse condition

Fresh and dry weight, fresh and dry ratio and length of shoot and root at the end of the season								
Genotypes	**Open field**				**Polyhouse**			
	Root: Shoot		**Length (cm)**		**Root: Shoot**		**Length (cm)**	
	Fresh weight basis	**Dry weight basis**	**Shoot**	**Root**	**Fresh weight basis**	**Dry weight basis**	**Shoot**	**Root**
Daisy	0.153	0.183	26.75	21.00	0.056	0.046	26.75	10.30
Phlox	0.017	0.026	52.50	14.00	0.523	0.051	92.00	8.10
Ice Plant	0.016	0.019	53.90	11.85	0.066	0.107	75.50	15.00
Helichrysum	0.121	0.134	109.25	23.00	0.055	0.084	125.00	16.25
Larkspur	0.073	0.090	70.25	17.00	0.054	0.061	60.25	7.25
Antirrhinum	0.033	0.065	83.50	20.50	0.027	0.040	132.50	13.00
Calendula	0.238	0.266	67.50	28.25	0.040	0.151	103.00	13.50
Sweet William	0.077	0.128	48.00	16.05	0.035	0.041	87.50	13.50
Petunia	0.034	0.078	89.25	20.75	0.040	0.088	113.50	14.60
Lupin	0.051	0.075	77.50	13.75	0.069	0.086	83.70	7.25
Brachycome	0.025	0.027	29.50	16.50	0.032	0.041	67.60	8.30
Cornflower	0.084	0.117	104.00	16.25	0.104	0.198	87.00	8.50
Dimorphotheca	0.055	0.094	62.50	25.00	0.024	0.044	117.50	12.00
Dianthus	0.039	0.063	53.25	18.00	0.030	0.052	109.00	12.50
Californian Poppy	0.084	0.108	51.50	19.50	0.051	0.071	109.50	13.00
Shirley Poppy	0.051	0.087	81.50	17.25	0.039	0.087	116.00	8.75
Pansy	0.038	0.100	45.50	19.00	0.033	0.043	85.00	12.10
Candytuft	0.041	0.071	40.50	15.60	0.040	0.100	75.50	12.25
Coreopsis	0.032	0.087	69.00	14.25	0.064	0.254	118.20	10.40
Sweet Pea	0.155	0.335	98.25	10.10	0.067	0.208	105.25	6.35
Pr>F	<.0001	<.0001	<.0001	<.0001	0.0046	0.0366	0.90	0.24
CD	0.0235	0.0375	8.5994	4.1346	0.1831	0.124	101.96	7.2809

Table 5: Plant height at 15 days interval starting from 30 DAT under open field and polyhouse

Genotypes	**Plant Height at 15 Days Interval**							
	Open field				**Polyhouse**			
	30 DAT	**45 DAT**	**60 DAT**	**75 DAT**	**30 DAT**	**45 DAT**	**60 DAT**	**75 DAT**
Daisy	7.64	13.65	22.17	26.08	10.99	22.04	28.72	32.20
Phlox	9.05	23.77	38.25	50.74	26.37	53.32	82.32	97.09
Ice Plant	16.37	23.94	44.25	52.84	18.79	37.00	46.14	54.90
Helichrysum	25.57	60.20	83.59	99.74	30.27	77.88	115.92	133.30
Larkspur	8.84	29.18	53.85	69.24	11.02	35.99	45.40	54.65
Antirrhinum	11.12	29.49	53.15	68.13	13.62	41.80	68.97	84.78
Calendula	23.19	33.89	46.60	63.68	20.75	52.87	74.79	89.30
Sweet William	12.62	26.19	47.02	54.08	15.95	37.20	48.50	62.64
Petunia	9.32	19.14	45.13	67.50	14.64	52.29	94.52	133.99
Lupin	8.79	29.19	56.80	70.87	25.07	53.24	82.60	96.14
Brachycome	9.25	15.12	20.75	26.12	8.07	17.57	27.75	33.75
Cornflower	29.90	58.50	81.37	98.62	46.87	83.32	106.65	128.42
Dimorphotheca	17.87	29.38	46.02	56.67	29.17	65.20	91.55	108.12
Dianthus	10.30	28.07	46.49	55.78	18.75	37.90	53.52	70.55
Californian Poppy	11.30	23.30	44.57	56.14	14.87	33.05	63.90	77.82
Shirley Poppy	18.07	28.25	63.29	76.39	25.15	59.59	82.40	96.40
Pansy	10.52	21.60	40.29	49.12	19.50	50.64	79.40	95.72
Candytuft	15.44	24.62	37.80	47.10	20.79	43.49	52.69	62.24
Coreopsis	9.53	26.24	51.84	67.72	14.72	47.02	86.50	105.52
Sweet Pea	20.34	29.34	73.07	92.05	33.84	61.80	95.89	118.14
Pr>F	0.0003	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
CD	8.0988	8.0008	9.6405	6.6699	6.6941	10.965	7.6265	7.0501

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