

CHAPTER 2.7

Seasonal variation in morphometric characters of *Cirsium*.

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INTRODUCTION

There is little documentation of seasonal variation in capitulum development in the Asteraceae despite the interest in capitula size as a factor in pre-dispersal seed predation (Fenner *et al.* 2002; Gluesenkamp 1994). However, temporal variation of capitula is an apparent concern to the agricultural producers of chamomile (Ohe *et al.* 1995) and artichokes (Vannella *et al.* 2000). In artichokes, which are a thistle, the harvest quality declines over the course of 5 to 6 weeks from the large primary heads to a point where the small secondary heads produced are not marketable as fresh produce, but rather are preserved in oil as artichoke hearts.

The differences between primary heads and secondary heads can be quite marked in *Cirsium* (pers. obs.). This can be a source of confusion when comparing collections made during different parts of the season. I became aware of this as a potential problem in the study of the *C. arizonicum* complex when I noted a great deal of variability in a population which had been collected both early and late in the season. This short study documents some seasonal changes in thistle morphology.

MATERIALS AND METHODS

Collections and data

The collections compared were made at milepost 110 along US Highway 64 in Gobernador Canyon, New Mexico. The thistles grow on a steep south-facing embankment approximately 200 feet long. This population was collected as follows: 1) on 4 September 1994, six plants (total six specimens); and 2) on 20 June 1997, two specimens from each of 5 plants (total 10 specimens).

As described in the previous chapters, floral, basal leaf, and involucre characters were measured on each specimen (Table 1). Each floral character was measured on 12 florets from each specimen and each leaf lobe character was measured on the largest lobes on both sides of the leaf.

Analyses

It is important to establish the significance of apparent differences in morphology between the two collections. The Wilcoxon Two-Sample Rank Sum test was performed using the software Jmp In (1989) to test for significant differences. To determine whether the changes were proportional (one set just being a diminutive version of the other) rather than allometric (shaped differently), subsets of the data were transformed to Z-scores by subtracting the mean and dividing by the standard deviation for the entire data-set, then projected as star plots. The subsets examined were the individual florets for the floret characters (TUBE, THRO, LOBE, STYL, ATIP and ABOD), and plant medians for the

TABLE 1. CHARACTERS COMPARED BETWEEN COLLECTIONS.

CHARACTER	TAG
Corolla tube length	TUBE
Corolla throat length	THRO
Corolla lobe length	LOBE
Style tip length	STYL
Anther appendage body length	ABOD
Anther appendage tip length	ATIP
Basal leaf length	LFLNG
Leaf tip length	TPLNG
Leaf tip width	TPWID
Leaf terminal spine length	TSPN
Number of leaf lobes	NLOBES
Maximum lobe extension	ML
Proximal lobe length	PL
Distal lobe length	DL
Basal lobe width	BW
Maximum lobe width	MW
Lobe spine length	SL
Lobe spine width	SD
Leaf webbing width	WW
Leaf-lobe interveinal distance	IVD
Pappus length	PAPLNG
Involucre height	INVHT
Middle phyllary spine length	PHSP
Upper leaf decurrence	DECUR
Pollen viability	POLLEN

same floret characters, and the seven most reliable characters: PAPLNG, INVHT, PHSP, DECUR, THROAT, LOBE, and STYL.

RESULTS

The median measurements for 12 of the 24 characters (pollen viability not included as a character) were significantly different between the samples (Table 2). ATIP and NLOBES were larger in the September collection, while TUBE, THRO, LOBE, STYL, ABOD, TPLNG, TSPN, ML, PL and MW were all significantly smaller in the September collection. Pollen viability remained statistically similar with a mixture of scores from 50% to 90% viable in each collection.

TABLE 2. COMPARISON OF JUNE AND SEPTEMBER COLLECTIONS BY WILCOXON 2-SAMPLE RANK SUM TESTS. Significant probabilities are shown in bold.

TAG	N measures Sept 1994	N measures June 1997	MEDIAN Sept 1994	MEDIAN June 1997	S	Z	Prob > Z
TUBE	37	118	7.44	10.06	997.5	-7.93	< 0.0001
THRO	43	118	5.87	7.455	1556.5	-7.36	< 0.0001
LOBE	47	118	9.52	11.4	1809.5	-7.55	< 0.0001
STYL	32	116	2.285	3.395	689	-7.89	< 0.0001
ABOD	45	118	1.95	2.36	2282.5	-5.22	< 0.0001
ATIP	45	118	0.67	0.58	4950	4.68	< 0.0001
LFLNG	6	8	228.5	292.5	40	-1.14	0.255
TPLNG	6	8	16.295	30.96	25	-2.52	0.012
TPWID	6	8	4.045	6.935	33	-1.48	0.138
TSPN	4	8	2.37	3.705	13	-2.12	0.034
NLOBES	12	18	14	10.5	259	3.10	0.002
ML	12	18	30.055	42.58	126	-2.52	0.012
PL	12	18	36.985	44.165	131	-2.31	0.021
DL	12	18	23.2	24.8	150	-1.50	0.133
BW	12	18	12.025	11.305	212	1.08	0.280
MW	12	18	17.24	23.805	136	-2.09	0.036
SL	12	18	4.295	4.205	184	-0.06	0.949
SD	12	18	0.355	0.31	197	0.44	0.656
WW	12	18	3.72	3.915	193	0.275	0.783
IVD	12	18	18.675	27.525	143	-1.80	0.072
PAPLNG	2	10	20.305	21.985	9	-0.75	0.452
INVHT	2	10	21.72	24.51	10	-0.57	0.591
PHSP	2	10	3.2	2.585	21	1.61	0.107
DECUR	2	10	4.54	3.775	15	0.32	0.747
POLLEN	4 (704 grains)	8 (1600 grains)	0.825	0.77	27	0.08	0.932

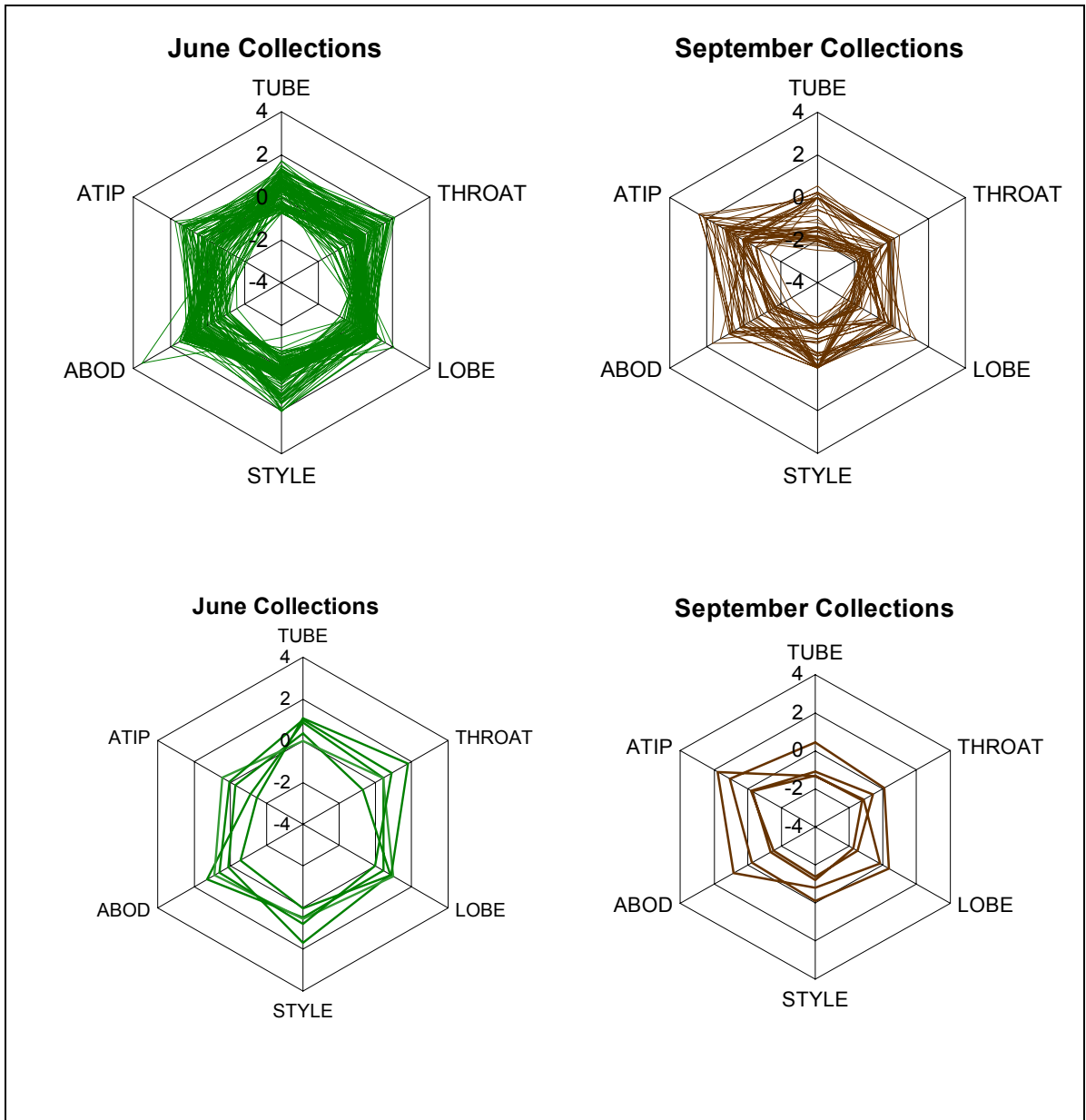
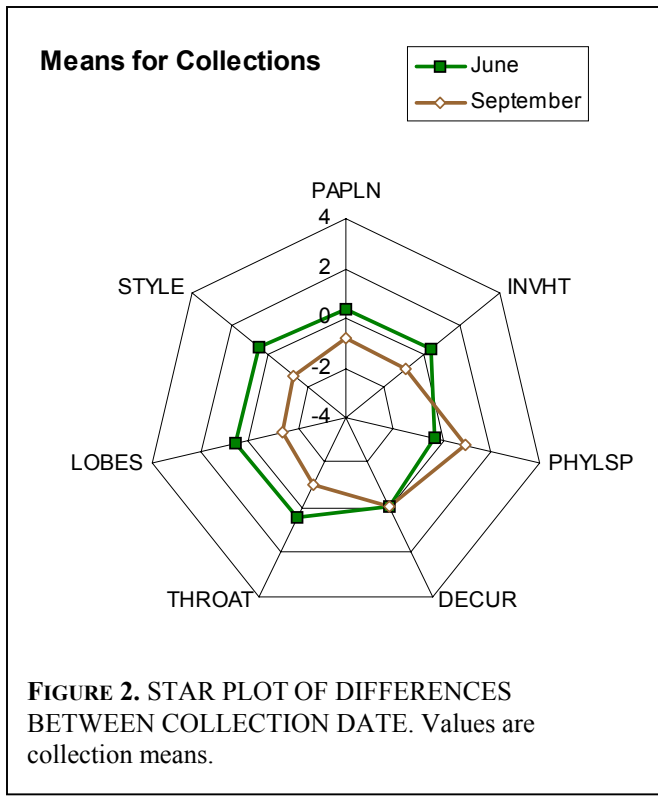


FIGURE 1. STAR PLOTS FOR FLORET VARIABLES. Top row represents individual measurements of florets. N=118 for June and N=45 for September. Bottom row represents medians for plants. N=5 for June, N=4 for September. Values are Z-scores to make all characters proportional.

Figure 1 shows the changes in proportions between June and September. ATIP changed the least, while TUBE changed the most. All of these changes are significant (see Table 2).



Using the most "reliable" variables according to all previous chapters, the quantitative profile of the two collections are not equivalent (Figure 2).

DISCUSSION

This study adds to the dimensions of intra-individual variation in which thistles are known to vary. Not only do they vary across the receptacle, up and down the stem, from leaf

side to leaf side, but many of these variations also have a temporal component. In the end, we are left with a question: what features allow us to visually recognize and

differentiate taxa?

TABLE 3 . DISTRIBUTION OF COLLECTION DATES FOR *CIRSIUM ARIZONICUM* STUDY SPECIMENS AS A "STEM AND LEAF" PLOT. This type of plot, developed by Tukey (1977), has nothing to do with vegetation, but rather is a graphical device. Here the "stem" is the weeks and the "leaves" are the day of the month.

WEEK	DATES (day of the month)	COUNT
JUNE 18	22	1
JUNE 25		0
JULY 2		0
JULY 9		0
JULY 16	22,22,23,23,23,24	6
JULY 26	29	1
AUGUST 30	30,4,5,6	4
AUGUST 6	11,11,11,11	4
AUGUST 13	14,14,15,15,17,17,17,18,18,18,18,18,18,19,19,19,19,19,19	19
AUGUST 20	23,23,24,24,24,25,25,25	8
SEPT. 27	27,27,28,28,28,1	6
SEPT. 3	3,4,4,4,4,4,5,5,9,9,9	11
SEPT. 10		0

As problematic as this temporal variation seems, because my study group contains only one spring collection (Table 3), it does not compromise the comparability of my collections. However, it is a factor that must be considered in evaluating the significance of

differences observed between herbarium specimens and should be of concern in the design of studies involving thistle collections.

SUMMARY

A component of season variation is shown to affect morphometric features of several thistle characters. This variation is not simply proportional but involves changes in allometric relationships.

LITERATURE CITED

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