

III. Variation in Flower-heads of *Gaillardia Aristata*.

By W. W. ROBBINS.

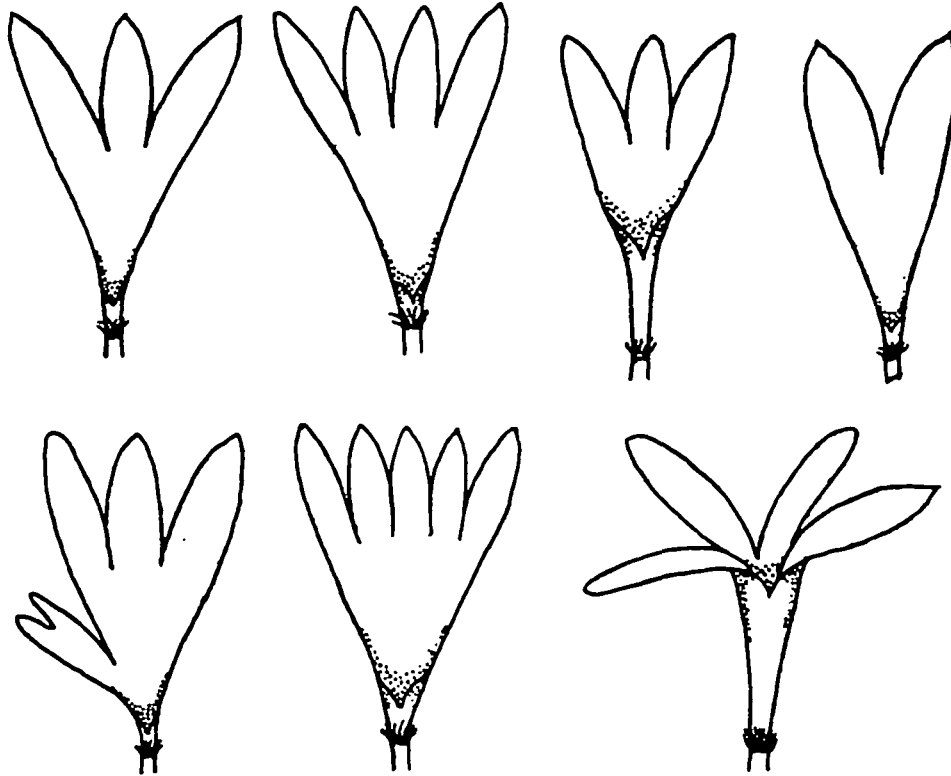
This conspicuous Composite has flower-heads about 6 cm. broad with purplish-brown centres and bright orange rays. In some heads a part of the rays are of the usual length and colour but tubular (*Torreyi*, vl. 180, 1906) as was noted by the writer in a previous paper. During the summer of 1907 from July 17 to August 14 a collection of 500 flower-heads was made from localities in the neighbourhood of Boulder.

Gaillardia aristata commonly grows in loose soil where there is not much water. About one-half of the flower-heads studied were, however, collected at an altitude of 9000 feet, from plants growing in an aspen grove. These plants were well-developed and the rays larger than those in plants found growing in the open. Other than this no special variation has been noted in the rays of plants growing in different altitudes and habitats.

Records were made of the number and character of all the ray-flowers in each head studied. A part of the data appear in the following table.

1	2	3	4	5	6	7	8
Number of rays in a head	Number of heads	Number of heads with all the rays ligulate	Number of heads with all the rays tubular	Number of heads with mixed ligulate and tubular rays	Percentage of heads with all the rays ligulate	Percentage of heads with all the rays tubular	Percentage of heads with mixed ligulate and tubular rays
9	1	1	0	0	100	0	0
10	8	5	0	3	63	0	38
11	23	16	0	7	69	0	31
12	33	27	0	6	81	0	19
13	123	95	1	27	77.2	0.9	21.9
14	53	40	1	12	75.4	2	22.6
15	47	31	1	15	65.9	2.2	31.9
16	55	41	1	13	74.5	1.9	23.6
17	45	33	0	12	73	0	27
18	33	21	0	12	63	0	37
19	21	14	1	6	66.6	4.9	28.5
20	21	10	0	11	47	0	53
21	8	7	0	1	87	0	13
22	13	6	1	6	46.1	6.8	46.1
23	5	2	0	3	40	0	60
24	4	1	0	3	25	0	75
25	1	0	0	1	0	0	100
26	2	0	0	2	0	0	100
27	0	0	0	0	0	0	0
28	3	0	0	3	0	0	100
33	1	0	0	1	0	0	100
	500	350	6	144	70	1.2	28.8

To illustrate what the table shows the 13-rayed head may be taken as an example. Columns 1 and 2 show that of the 500 heads examined 123 had 13 rays in a head. Column 3 shows that 95 of these had all ligulate rays; Column 4 shows that 1 had all tubular rays; Column 5 shows



Various forms of ray-flowers seen in the flower-heads of *Gaillardia aristata* $\times 11$.

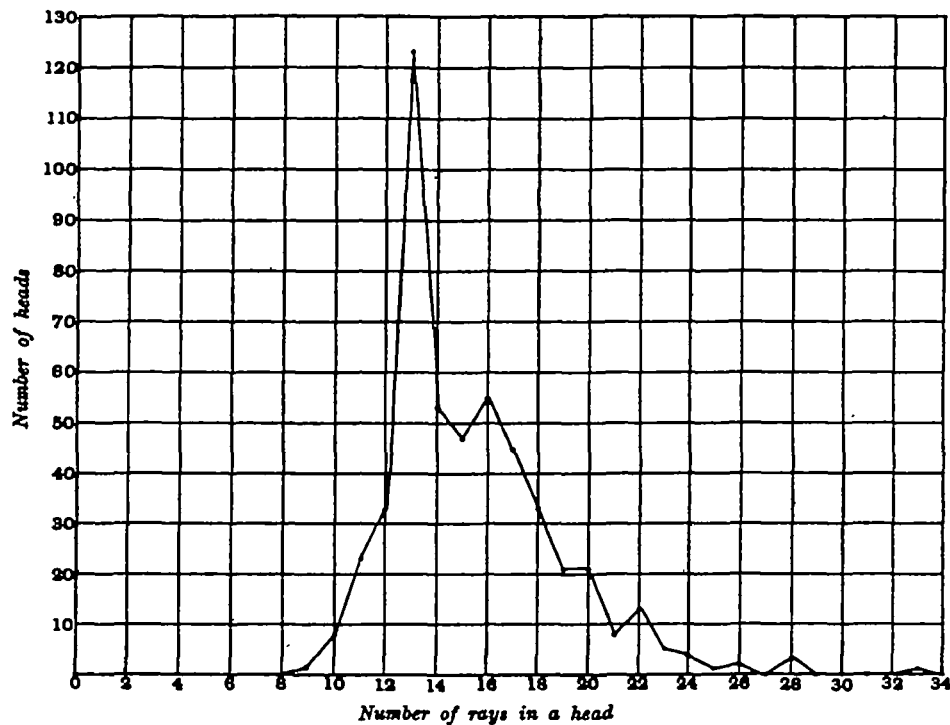
that 27 had mixed ligulate and tubular rays. Columns 6, 7 and 8 deal with percentages; it is seen that 77.2 is the percentage of 13-rayed heads with all ligulate flowers; 0.9 the percentage of 13-rayed heads with all rays tubular, and 21.9 the percentage of 13-rayed heads with mixed tubular and ligulate rays.

It is seen that when the number of rays in a head is large both ligulate and tubular rays are apt to occur. While with fewer rays in a head there are some instances in which all the flowers are tubular and many in which all are ligulate. The normal head has all ligulate rays, but a percentage of 28.8 heads with mixed ligulate and tubular rays shows a strong tendency to vary from this normal.

The accompanying curve of variation for the number of rays is computed from columns 1 and 2 of the foregoing table. It includes all rays without regard to their form. There is a well-developed mode at 13 and the usual skewness to the right which may be expected in all such studies as the present one.

The 500 flower-heads examined had a total of 7709 rays. The larger part of these rays were three-lobed and ligulate but some had as many as six lobes and a single specimen had only one lobe. In the following table the records for all of these flowers are tabulated. It includes therefore both ligulate and tubular rays.

It will be seen from the table on p. 108 that while the ligulate rays have as a rule three lobes, the tubular rays are more often four-lobed. The percentage of ligulate rays decreases and the percentage of tubular rays increases with an increase in the number of the lobes.



Record of 7709 Ray-Flowers in 500 Flower-Heads.

	f. Ligulate	f. Tubular	% Ligulate	% Tubular
1-lobed flowers ...	1	0	100	0
2-lobed flowers ...	183	0	100	0
3-lobed flowers ...	5908	146	98	2
4-lobed flowers ...	893	296	75	25
5-lobed flowers ...	78	183	30	70
6-lobed flowers ...	0	11	0	100
	7073	636	92	8

Summary. The normal flower-head of *Gaillardia aristata* has 13 three-lobed ligulate rays. Variation from the normal, however, is common and occurs in the number and form of the rays and in the number of lobes in a ray. The tendency to vary is toward a flower-head having a larger number of rays, mixed ligulate and tubular, the latter being four-lobed. A few heads are found with all the rays tubular.

UNIVERSITY OF COLORADO,
BOULDER, COLO.

[It is worth noting that the Fibonacci mode series (see *Biometrika*, Vol. I. p. 306), namely, 5, 8, 13, 21, 34..., is not represented in the sub-modes of *Gaillardia aristata*; and, except for the primary mode 13, there is no evidence in favour of the Fibonacci doctrine from the data. Ed.]