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Tissue weight and water content in a tetracotyledonous mutant of Phaseolus vulgaris.

By J. ARTHUR HARRIS.

[*From the Station for Experimental Evolution, Cold Spring Harbor, L. I.*]

In 1915 studies of the tissues of normal and variant bean seedlings were begun in an effort to explain the differential mortality with respect to morphological characters demonstrated in an earlier experiment.[1]

In a first paper[2] it was demonstrated that teratological seedlings show a lower capacity for the development of primordial leaf tissue than do normal individuals of the same strain grown under conditions as nearly as possible identical. In these first experiments the conclusions were based upon the green weight of primordial leaves.

In a second study, tissue weight determinations were based on the trifoliate leaves of the third node as well as on the primordial leaves of the second node.[3] In these two investigations we attempted to determine to what extent morphologically aberrant seedlings differ from the normal seedlings of the race to which they belong in their physiological characters in so far as these can be measured by the capacity for the production of tissue. The results indicated that teratological seedlings show a lower capacity

[1] Harris, J. Arthur, *Science*, 1912, N. S., xxxvi, 713–715.

[2] Harris, J. Arthur, *Genetics*, 1916, i, 185–196.

[3] Harris, J. Arthur, Brooklyn Botanic Garden Memoirs, 1918, i, 167–174.

for tissue production as measured both by green weight and dry weight in primordial and first compound leaves than do their normal controls.

In a subsequent series of investigations we have instituted comparisons between the highly abnormal seedlings of a tetracotyledonous race of Phaseolus[1] and the normal seedlings of the parental race from which it originated.

The tetracotyledonous race is characterized by a modal number of four cotyledons and four primordial leaves but both of these characters are highly variable.

Classifying the tetracotyledonous plants according to number of primordial leaves, we have the mean green weight and the mean dry weight of primordial leaf tissue in teratological and normal seedlings shown in the accompanying table.

The data are given as average weights per plant and per leaf. The average per cent. of dry substance is shown in the final column of the table. All the values are averages of constants based on samples of approximately 100 plants.

The data show that without exception the mean green weight and the mean dry weight per plant of primordial leaf tissue is lower in the tetracotyledonous race than in the normal race.

The mean percentage differences (obtained by using the constants for the normal plants as a base) for green weight per plant range from -3.10 for the plants with six primordial leaves[2] to -31.55 per cent. for group of plants with 2 primordial leaves.

The percentage differences for dry weight of primordial leaves in tetracotyledonous and dicotyledonous races vary from -7.93 per cent. for the group of plants with 6 primordial leaves to -32.55 for plants of the tetracotyledonous race with 2 primordial leaves.

It will be noted that the difference between the abnormal and the normal plants decreases as the number of primordial leaves on the abnormal plants increases.

The results for the average green and dry weight per leaf in the mutant and normal series fully substantiate the conclusions

[1] Harris, J. Arthur, *Proceedings National Academy of Science*, 1916, ii, 317–318. Harris, J. Arthur, Memoir, N. Y. Botanical Garden, 1916, vi, 229–244.

[2] Theoretically plants with 7 leaves should have shown a smaller difference than seedlings with six leaves but the number of seedlings available was not so large and the constant is therefore not as trustworthy.

concerning the physiological differentiation of the two races to be drawn from the average weights per plant.

The differences in the average percentage of dry substance vary considerably but it is impossible to state in the absence of probable errors that the ratio differs from class to class.

The foregoing results for a heritable abnormal race substantiate the conclusions concerning the association of physiological with morphological differences already drawn from a comparison of variant and normal individuals within the same race.

Number of Leaves of Abnormal Race.	Pairs of Plants.	Value per Plant.		Value per Leaf.		Per cent. Dry Substance.
		Mean Green Weight.	Mean Dry Weight.	Mean Green Weight.	Mean Dry Weight.	
2 Leaves						
Abnormal	196	.52390	.03790	.26195	.01900	7.3090
Control	196	.76285	.05645	.38145	.02825	7.4350
Difference		−.23895	−.01855	−.11950	−.00925	−.1260
Percentage difference		−31.55	−32.55	−31.55	−32.40	
3 Leaves						
Abnormal	500	.61086	.04174	.20360	.01392	6.8516
Control	500	.77094	.05606	.38550	.02806	7.2842
Difference		−.16008	−.01432	−.18190	−.01414	−.4326
Percentage difference		−20.74	−25.54	−47.16	−50.38	
4 Leaves						
Abnormal	700	.68947	.04587	.17238	.01147	6.6918
Control	700	.78631	.05501	.39318	.02751	7.0305
Difference		−.09684	−.00914	−.22080	−.01604	−.3387
Percentage difference		−11.97	−16.34	−55.95	−58.12	
5 Leaves						
Abnormal	500	.70542	.04740	.14108	.00948	6.7618
Control	500	.77152	.05504	.38580	.02754	7.1692
Difference		−.06610	−.00764	−.24472	−.01806	−.4074
Percentage difference		−8.60	−13.78	−63.46	−65.52	
6 Leaves						
Abnormal	300	.74746	.05146	.12456	.00860	6.9076
Control	300	.77206	.05596	.38603	.02796	7.2616
Difference		−.02460	−.00446	−.26146	−.01936	−.3540
Percentage difference		−3.10	−7.93	−67.66	−69.16	
7 Leaves						
Abnormal	138	.73120	.05570	.10450	.00800	7.6200
Control	138	.77850	.06140	.38930	.03070	7.8920
Difference		−.04730	−.00570	−.28480	−.02270	−.2720
Percentage difference		−6.00	−16.76	−73.10	−73.90	