STRUCTURAL AND METABOLIC AFTER-EFFECTS OF SOAKING SEEDS OF PHASEOLUS*

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The purpose of this investigation was to determine the effects of soaking the seeds on the germination and on the number of mature plants produced, weight of plants and rate of growth, stem and leaf structure, percentage of water and dry matter in the plants, relative abundance of various carbohydrates and nitrogen compounds, rate of respiration and catalase activity.

Early Valentine beans *(Phaseolus vulgaris)* were used. The seeds, after being sterilized, were soaked in sterilized distilled water, with aeration except in the study of the effects of soaking on catalase activity. The periods of soaking varied from 8 hours to 9 days. The seeds were planted in the greenhouse. The plants were harvested when they had reached the blooming stage.

The result are shown in the following tables:

TABLE I

Influence of Seed Treatment on Germination (Appearance of Seedlings at Surface of Soil), Number of Mature Plants Produced, Average Weight, and Number of Days Required to Reach Maturity

Period of treatment	No. of seeds	No. germinated	Percentage germination	No. of mature plants	Percentage matured	Average weight of plants (gm.)	Days to reach maturity
Untreated	100	95	95.00	91	91.00	26.26	37
8 hours	120	97	80.83	84	70.00	24.50	38
2 days	120	76	63.33	71	59.17	22.88	38
5 days	140	46	32.86	31	22.14	17.48	43
7 days	140	7	5.00	3	2.14	16.67	48
9 days	140	1	0.71	1	0.71	14.50	46

TABLE II

Influence of Seed Treatment on Stem Structure

Seed treatment	Av. thickness of phloem	Av. thickness of xylem	Ratio of phloem to xylem
Untreated	0.07953 mm.	0.474 mm.	0.168
5 days in H_2O	0.11550	0.452	0.255

TABLE III

Percentage of Dry Matter and Moisture

Seed treatment	Percentage	
	Dry matter	Moisture
Untreated	16.61	83.39
5 days in H_2O	19.05	80.95

TABLE IV

Carbohydrates Expressed as Percentages of Weights of the Carbohydrates Found in Plants from Untreated Seeds; Basis of Equal Weights of Wet and Dry Matter of Samples

Seed Treatment	Weight Basis											
	Glucose		Sucrose		Total Sugars		Starch		Hemicelluloses		Total Carbohydrates	
	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
None	100	100	100	100	100	100	100	100	100	100	100	100
5 days in H_2O	148	129	111	94	129	111	243	223	110	93	151	131

TABLE V

Total Nitrogen, Organic Nitrogen, Amino-Acid Nitrogen, and Proteins Expressed as Percentages of Weights of These Found in Plants from Untreated Seeds; Basis of Equal Weights of Wet and Dry Matter of Samples

Seed Treatment	Weight Basis							
	Total Nitrogen		Organic Nitrogen		Amino-Acid Nitrogen		Proteins	
	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
None	100	100	100	100	100	100	100	100
5 days in H_2O	87	76	87	76	80	70	93	81

TABLE VI

Weight of Respiratory Carbon Dioxide Given off Per 100 GM. of Dry Matter in 10 Hours

	Seed Treatment	
	Untreated	3 Days in H_2O
Grams of CO_2	1.191	1.568

TABLE VII

Volume of Oxygen Liberated by Catalase Action and Percentage of Oxygen on Basis of That Liberated by Untreated Seeds; Seeds Soaked with Aeration; Volumes Corrected to 0° C. and 760 MM. Pressure; 10-Minute Runs

Seed Treatment	0.2 GM. Air-dry Material (CC.)	1.0 GM. Air-dry Material (CC.)	1.0 GM. Dry Matter (CC.)	Percentage Oxygen
Untreated	19.97	99.85	113.04	100.00
2 days in H_2O	19.04	95.20	108.02	95.56
5 days in H_2O	22.49	112.45	129.47	114.53

TABLE VIII

Volume of Oxygen Liberated by Catalase Action and Percentage Oxygen on Basis of That Liberated by Untreated Seeds; Seeds Soaked without Aeration; Volumes Corrected to 0° C. and 760 MM. Pressure; 10-Minute Runs

Seed Treatment	0.2 GM. Air-Dry Material (CC.)	1.0 GM. Air-Dry Material (CC.)	1.0 GM. Dry Matter (CC.)	Percentage Oxygen
Untreated	23.02	115.10	125.89	100.00
2 days in H_2O	20.32	101.60	111.87	88.86
5 days in H_2O	19.27	96.35	106.43	84.54

From the data it will be seen that soaking the seeds of dwarf bean in distilled water with aeration resulted in a progressive decrease in the rate of germination, in a further reduction in the number of mature plants produced, in a progressive decrease in the growth and weight of the plants produced, and in an increase in the time required for the plants to reach maturity.

In the stems there was a greater average thickness of phloem and a higher ratio of the phloem to the xylem in the plants from the soaked seeds. There was also a modification of leaf structure, the leaf blades of plants from treated seeds generally being thinner and more compact in structure than those of plants from untreated seeds.

In the plants from soaked seeds there was a marked relative increase in reducing sugars, starch, and total carbohydrates, also an increase in solid matter, and a relative decrease in total nitrogen, organic nitrogen, amino-acid nitrogen, and proteins, in comparison with the plants from untreated seeds.

Soaking the seeds before sprouting resulted in an increase in the rate of the production of respiratory carbon dioxide. The seeds sprouted after previous soaking contained 63.9 per cent of water, while those sprouted without previous soaking contained 53.7 per cent of water.

Soaking the seeds without aeration resulted in a regular decrease in catalase activity. Soaking with aeration resulted at first in a small decrease in catalase activity, but this was soon followed by a considerable increase. This modification of the result is doubtless due to the fact that the seeds when soaked with aeration passed through the early stages of germination, with a consequent increase in catalase activity.