

THE EFFECT OF AERATION ON PLANTS.

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A series of experiments on aeration, of which the ones here mentioned are a beginning, are being carried out to show what effect will be produced on a considerable number of plants of different families and species and under different conditions. Some of these have shown, as would be expected, a considerable difference as regards their response when placed under these conditions. It goes without saying that carefully grown and equally vigorous and large controls to begin with should always be used and kept under precisely the same conditions except that they are not aerated.

In 1917 Beals¹ carried out under my direction some experiments on the aeration of *Zea Mays*. In this paper marked differences were shown between the aerated and the non-aerated specimens as is well shown by reference to his figures. In 1919 a second paper by Andrews and Beals² gave the results of further research on this subject. It became necessary in this paper first to ascertain the requisite amount of time for soaking the material at hand previous to its germination. The second part of the paper deals with the effect of aeration. The experiments on aeration were carried out on a more extensive scale than had been done in the above mentioned paper by Beals.³ This paper not only substantiated the work of Beals but extended it in various ways especially as to the different quantities of air used and temperature. The photographs show the acceleration produced by aeration which was marked in every case. The literature on the subject of Aeration of plants is referred to in the paper of Andrews and Beals and further reference to it will not be made in these experiments.

The first plants used in this series of experiments were those of *Avena sativa*. Seedlings of equal size were fastened in the usual way in paraffined wooden lids on 1500 cc jars which contained Sachs nutrient solution. From the first the aired specimens grew fastest and more nearly normal in every respect. Both specimens, however, soon required supports since after attaining some height they were unable to stand upright. To effect this ring stands supplied with large rings were used and the upper portions of the growing plants were then passed through the rings. In the control plant only two supporting rings were needed but the specimen that had been aired had grown to such an extent that three rings, widely separated on the ring stand, were required. At the expiration of the experiment the aired specimen of *Avena sativa* was 70 cm. high while the unaired plant was 40 cm high. Both plants were then dried and weighed. The dry weight of the aired specimen was 3.5 grs. while the dry weight of the unaired plant was 1 gr. The transpiratory activity of the aired specimen was also much greater as would be expected than the unaired plant. The root system of the aired plant was much greater and more extensive in every respect than that

¹Beals, Colonzo C. The effect of Aeration on the Roots of *Zea Mays*. Proc. Indiana Acad. Sci. 1917, PP. 177-180.

²Andrews, F. M. and Beals, Colonzo C. The effect of Soaking in water and of aeration on the Growth of *Zea Mays*. Bulletin of the Torrey Bot. Club. 1919, Vol. 46, PP. 91-100.

³Beals, Colonzo C., l. c.

of the unaired plant. This was made necessary by the greater transpiration and growth activities of the plant which was aired in the way mentioned. The air used to aerate the specimen of *Avena sativa* as well as the others mentioned in this paper was propelled by the Kekulé apparatus.

In like manner air was passed through a Sachs culture solution in which were growing seedlings of *Brassica alba*. Here again the aired specimen showed a great advance over the unaired plant. When the plants were two weeks old the aired specimen was 12 cm. high, while the unaired specimen was 5 cm., high. The roots of the unaired specimen were rather few and long, while those of the aired specimen were aggregated more into a mass of considerable size, were much denser and more numerous and the total length many times greater. The aerial portion of the aired plant was not only taller but more than twice as broad. The leaves of the aired plant were much larger and broader and more numerous and the transpiratory activity as in *Avena sativa* was much increased. The comparative difference in size of the aired and unaired specimens of *Brassica alba* was a little greater as the measurements will show, than the difference in size of the *Avena sativa* plants. The dried weight of the aired specimen of *Brassica alba* was 110 mg. while that of the unaired specimen was 25 mg.

Seedlings of *Pisum sativum* were grown in a Sachs nutrient solution as the above mentioned specimens some of which were aired and some not aired. Here again the aired specimen grew fastest and best. When twenty days old the aired seedlings were 85 cm. high and the non-aired 41 cm. high. The dry weight of the aired plant was 2.5 grs. while that of the unaired plant was 0.5 gr. In this experiment the aired specimen was nearly twice the height of the unaired plant while the dry weight exceeded that of the unaired five times.

Other experiments on *Fagopyrum esculentum* and on *Helianthus annuus* gave similar differences. The plants of *Fagopyrum esculentum* especially showed decided differences. Those specimens that were aired formed flowers profusely two weeks sooner than the specimens which had not been aired.

In addition to the above experiments which is only an outline of part of the work done, Miss E. G. James is at present working on an extended series of experiments on aeration of plants under my direction. She has invented several new and necessary pieces of apparatus for carrying out the work under different conditions. Experiments performed by her on *Lactuca sativa* confirm my experiments and also extend them in various ways.