SOME EFFECTS OF WIND INJURY TO GROWING PLANTS

H. H. FINNELL
PANHANDLE AGRICULTURAL EXPERIMENT STATION

ATTENTION WAS first directed to this subject by a study of factors affecting the yields from field plots at the Panhandle Agricultural Experiment Station.[1] Among other climatic factors to which correlation with yield was applied wind appeared to be of considerable importance. The simple correlation between velocity of wind and crop yield was $-0.62 \mp .04$. In a multiple correlation with a coefficient of 0.90 wind showed a percentage score of -18.5. The only other more significant factor included in the study was temperature which scored -24.8%. Since such factors as rainfall, humidity and soil moisture were reckoned with in the calculation it appeared to the writer that wind exerted a somewhat greater injurious effect than could reasonably be accounted for by an increased transpiration rate.

A preliminary greenhouse study with Marigolds followed.[2] It is the purpose of this paper to present results of later experiments with crop plants, sorghum and barley, and an investigation of the records of certain field plots with reference to the effect of wind velocity and windbreak protection upon field yields. Both sorghum and barley were planted in four inch clay pots and sealed brass cylinders. Each group was divided in half, one subgroup being exposed to a wind velocity of approximately 15 miles per hour and the other kept in the same room with other growing conditions uniformly maintained without the wind exposure.

All pots were thinned to nine plants at the time the test began, but a few of the seedlings died out later. Where there is a difference in the number of plants between wind exposed and check pots, the check pots always contained the fewer plants. This tended to encourage a taller growth in the check pots, but the advantage would register in favor of the wind exposed pots when total yields of green and dry matter were determined.

The moisture factor was eliminated by the daily addition of water sufficient to bring each pot back to the standard weight. When it became apparent that the plants were being crowded and a larger quantity of water was being demanded daily than the soil was able to supply, both night and morning waterings were employed.

The rate of growth was immediately reduced when the plants had reached a height sufficient for exposure above the rim of the pot. The difference in the rate of growth was most pronounced during the second ten-day period which was the time of most vigorous activity. During the third and fourth ten-day periods the rate of growth in all pots was less. It became apparent near the end of the test that the plants were almost at a standstill due to crowding.

In all cases a consistent depression in rate of growth as well as yield was observed in the wind exposed pots. No indication of the effect of wind upon stooling was obtained since the experiment was not carried to the

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[1]Finnell, H. H. 1928. Utilization of Moisture on Heavy Soils of the Southern Great Plains. Oklahoma Experiment Station (Paper Unpublished).

[2]———. 1928. Effect of Wind on Plant Growth. Jour. Amer. Soc. Agron. Vol. 20 Number 11.

stooling stage. There is a very slight indication that more leaves were formed during the forty-day growth period on wind exposed than on the checks. This, however, is not conclusive as was the difference in the number of secondary branches produced in the marigold experiment.

The record of water used by the different groups is of no interest from the standpoint of water requirement of the plants themselves since in most cases no attempt was made to prevent evaporation from the soil and pot surfaces. It does serve, however, to indicate the difference which wind makes in the water requirement. The decrease yield due to wind exposure was about 30% for sorghum and 24% for barley. A 48% depression was measured in the marigold experiment.

No reading of maturity was obtained with the sorghum and barley work as the plants were cut at 40 days. In the marigold experiment the check plants bloomed 10 days earlier than those exposed to wind.

Among the field experiments at Goodwell is a rotation being prepared for fertilizer trials by running through one crop cycle for plot standardization. The crops used were sudan grass, cowpeas, milo, wheat and a manure crop. The location of these plots was carefully chosen with reference to soil uniformity. A portion of the results from 1924 plantings had to be discarded on account of non-conformity of the previous cropping to the new layout.

This rotation gives a record of 30 pairs of adjacent plots in all respects treated alike excepting the exposure of the outside plot on the south side of each block to abnormally severe wind lashing. Ten of the comparisons are between plots the south one of which had no wind shelter. In nine of these ten instances the plot on the south yielded less than the one on the north. The average decrease was 14.94%. Twenty of the thirty comparisons are between plots which are equally protected by adjoining plots of the same crop or some other crop of equal or greater height. Of these 20 pairs 11 showed a smaller yield on the south plot while 9 showed a greater yield. The average difference was 1.20% in favor of the south plot.

Careful check was made of the stand counts of all these plots. Some variation was found which is no doubt responsible for certain degrees of difference but it was notable that stand variations favored one side as often as another. No data were excluded on this account. The correlation of wind velocity during the various seasons and the depression of yield in the exposed plot was not significant ($-0.18 \mp .15$). The effect of variation in the prevailing southerly winds of the normal growing season is not nearly so great as the presence or absence of a protective barrier.

Taken all together the bits of evidence on this subject seem to indicate that the detrimental effect of wind includes a complex of factors involving both physical injury to the plant and reduction of moisture using efficiency. Yields have been decreased both in the field under limited moisture conditions and in the greenhouse where all additional moisture requirements were supplied. Yield decreases were accompanied by the destruction of tender parts of the foliage. deformity of growing parts, reduction of the rate of growth, and delay of maturity. A tendency has also been noted for a plant to increase the number of leaves and branches when the growth has been retarded by wind exposure.

In the pot experiments where the moisture supply was not allowed to fall below the full requirements of the plant, it was evident that the

reduced rate of growth was due to other limiting factors aside from food and moisture scarcity in the soil. Some of the causes suggested are loss of leaf area, energy wasted in repair of tissues, interference with photosysthesis or translocation by the constant agitation, or reduced efficiency from the necessity of transpiring excessive quantities of water. However, the point in hand is that winds do considerable damage to plants even though they are supplied with additional water required to meet aggravated evaporation rates.

Table 1, Effects of Wind on Early Stage Growth of Pot Sorghums, 1928, 40 Day Tests

	In Open Clay Pots		In Sealed Brass Cylinders	
	Wind Exposed	Check	Wind Exposed	Check
Ave. Growth in cm. by 10 day periods				
1[1]	4.0	6.2	4.0	6.5
2	8.0	14.2	9.0	15.5
3	6.2	6.0	7.5	10.0
4	2.2	1.0	1.0	2.5
Total Growth	20.5	27.5	21.5	34.5
No. Plants per Pot	8.5	8.0	9.0	6.0
No. Leaves per Plant, Harvest				
Green	2.9	2.4	2.5	3.1
Dried	3.8	4.0	4.5	4.1
No. Total Leaves per Plant	6.7	6.4	7.0	7.2
Yield per Pot gm.				
Green Weight	6.1	8.4	9.2	14.2
Dry Weight	1.5	2.2	2.4	3.4
% Decrease	31.8	0.0	29.4	0.0
Ave. Daily Water Used per Pot, cc. 10 Day Periods				
1[1]	81.4	63.3	9.1	7.5
2	90.6	73.1	32.8	26.4
3	130.5	89.9	64.8	55.0
4	121.6	82.9	61.5	60.8
40 Day Period	107.3	78.0	43.5	38.7
Total Water Used, Pot, Waste and Plant	4079	2966	1655	1474
Water Used per Gram of Dry Matter Yielded	2719	1347	689	433

[1]Measurements are averaged for the last 8 days of the period, beginning after all seedlings had emerged.

Table 2, Effects of Wind on Early Stage Growth of Pot Barley, 1928, 40 Day Tests

	In Open Clay Pots		In Sealed Brass Cylinders	
	Wind Exposed	Check	Wind Exposed	Check
Ave. Growth in cm. by 10 day periods				
1[1]	2.5	2.0	2.0	2.5
2	3.0	7.5	4.0	6.5
3	3.5	4.2	4.5	5.5
4	1.2	1.7	2.5	2.5
Total Growth	10.2	15.5	13.0	17.0
No. Plants per Pot	9.0	9.0	9.0	7.0
No. Leaves per Plant at Harvest,				
Green	3.9	3.5	3.3	3.8
Dried	1.2	1.1	2.4	1.8
No. Total Leaves per Plant	5.1	4.6	5.7	5.6
Yield per Pot grams				
Green Weight	4.0	5.35	3.7	4.7
Dry Weight	.7	.95	.7	.9
Percentage Decrease	26.3	0.0	22.2	0.0
Ave. Daily Water Used per Pot, cc. 10 Day Periods				
1[1]	75.0	64.7	35.1	16.2
2	83.2	75.7	56.0	32.2
3	118.9	91.6	90.7	50.7
4	118.9	93.8	77.8	50.7
40 Day Period	100.3	82.3	65.5	38.5
Total Water Used, Pot Waste and Plant	3811	3128	2491	1466
Water Used per Gram of Dry Matter Yielded	5551	3297	3113	1628

[1]Measurements are averaged for the last 8 days of the period, beginning after all seedlings had emerged.