RELATIVE PHOTOSYNTHETIC CAPACITY OF STALKS, LEAF SHEATHS, AND LEAF BLADES IN MAIZE AS MEASURED BY THE CONTRIBUTION EACH MAKES TO THE DEVELOPMENT OF THE GRAIN

GEORGE H. DUNGAN

University of Illinois, Urbana, Illinois

From the extreme reduction in grain yield associated with the removal of all blades (1, 2, 3) from maize plants one might conclude that no filling of the grain takes place after defoliation. In order to get data on this question a field trial was made using U. S. Hybrid 13 (WF9 x 38-11) (Hy x L317) in the summer of 1941 at Urbana, Illinois.

In a block of two-plant hills twenty were selected which contained plants of approximately equal size. On August 15, when the kernels were in the roasting-ear or milk stage, the ear from the north or west plant in each hill was harvested. The ear on the other stalk was allowed to mature before it was harvested. From another group of twenty twin-plant hills both the blade and the sheath were removed from the north or west stalk. (Fig. 1) The other plant in these hills was uninjured. Ears from both were left on the stalks until normal time of harvest. From another group of twenty selected hills the north or west plant was treated by removal of the blades only. The neighbor plant in each hill of this group served as an untreated check.

Each ear was harvested in mid-November and tagged separately so that the yield of the treated plants could be compared with that of the untreated checks in the same hill. The results are presented in Table 1.

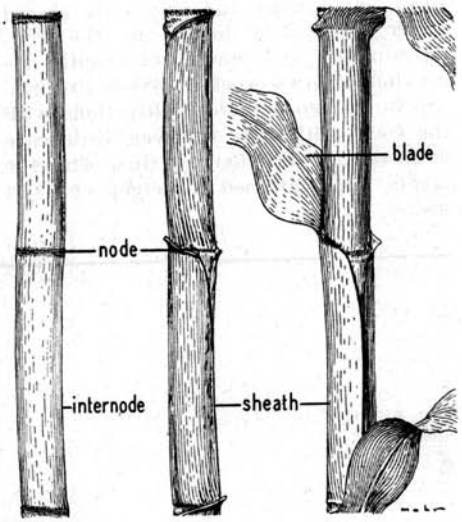

Fig. 1.—Stalks of corn illustrating both blades and sheaths removed (left); blades removed but sheath intact (center); and both blades and sheath intact (right). (Drawing by Dr. Carl Mohr).

TABLE 1.—YIELDS OF CORN PLANTS TREATED WHEN THE KERNELS WERE IN THE MILK STAGE BY (1) HARVESTING EARS, (2) REMOVING BOTH BLADES AND SHEATHS, AND (3) REMOVING THE BLADES ONLY COMPARED WITH NORMAL UNINJURED PLANTS. URBANA, 1941.

Treatment applied when kernels on the ears were in the milk stage	Yield per acre		Test weight per bushel	Weight of 1000 kernels
	Shelled corn	Cobs		
	bu.	lbs.	lbs.	gms.
Harvested ears	*19.7**	*690.8**	38.7	88.2
All blades and sheaths removed	*26.8*	*621.3*	45.8	104.0
All blades removed	*30.0*	*630.7*	47.9	126.1
None (normal, uninjured plants)	81.1	843.2	58.9	295.4

* Italicized data were accompanied by odds according to Student's method high enough to indicate distinct significance as compared with the untreated check.

Yield of shelled corn (Fig. 2) was lowest when the ears were harvested on the day the other plants were defoliated. This yield was about 7 bushels an acre lower than that obtained from plants having both blades and sheaths removed. The source of this greater yield may be in the photosynthesis by the chloroplasts in the green stalk, and in the translocation of reserve materials from the stalk and cob after the leaves were removed.

The yield of plants carrying leaf sheaths, but no blades, was a little over 3 bushels an acre more than that of plants from which both the sheaths and blades were cut away. This difference represents the photosynthetic activity of the sheaths. Taking off all blades at this stage of ear development lowered the yield 51 bushels an acre compared with plants on which the blades were allowed to remain.

The weight of cobs was about 70 pounds an acre greater when the ears were harvested in the milk stage than when all the blades and sheaths were removed at that stage. This indicates that the cobs of early harvested ears may have contained some grain-forming materials which, because of being removed from the stalk, were not translocated to the kernels.

Compared with ears harvested in the milk stage, ears left on stalks which were deprived of both blades and sheaths showed an increase in grain yield of 36 per cent, a decrease in cob weight of 10 per cent, an increase in bushel weight of 18 per cent, and an increase in weight of 1,000 kernels of 18 per cent. Leaving the ears on stalks from which the blades only were removed was associated with an increase in grain yield of 52 per cent, a decrease in cob weight of almost 9 per cent, and increase in weight per bushel and weight of 1,000 kernels of 24 and 43 per cent, respectively. Permitting the ears to remain on uninjured stalks until complete maturity increased the yield of shelled corn 312 per cent, the weight of cobs 22 per cent, the bushel weight 52 per cent, and the weight of 1,000 kernels 235 per cent.

Thus, the yield of shelled corn was made up of contributions as follows: 36 per cent from the green stalk alone, 17

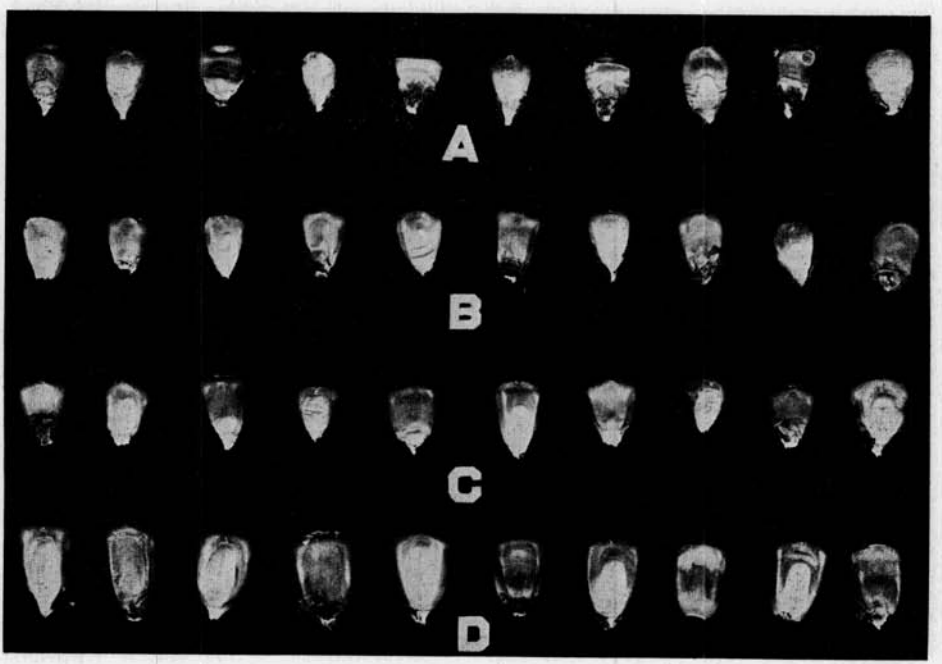

Fig. 2.—Representative kernels of maize produced by plants treated when the grain was in the milk stage by (A) harvesting the ears, (B) removing both blades and sheaths, (C) removing the blades, in comparison with (D) normal mature kernels produced on non-defoliated plants.

per cent from the leaf sheaths alone, and 259 per cent from the leaf blades alone. Considering only the development made after treatment, the bare stalk was responsible for 11.5 per cent, the leaf sheaths for 5.5 per cent, and the leaf blades for 83.0 per cent of the increase in yield of shelled corn.

LITERATURE CITED

1. Dungan, George H. Losses to the corn crop caused by leaf injury. Plant Physiology 9:749-766, 1934.
2. Eldredge, J. C. Hail damage to corn. Iowa Agr. Exp. Sta. Bul. 348. pp. 303-322. 1936.
3. Hume, A. N. and Franzke, Clifford. The effect of certain injuries to leaves of corn plants upon weights of grain produced. Jour. Amer. Soc. Agron. 21:1156-1164, 1929.