Comparative Strength of Corn Stalk Internodes1

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DEVELOPMENT of the crushing strength and rind thickness measurement techniques by Zuber and Grogan (17) was an important step in placing stalk lodging resistance, an essential corn breeding objective, on a more precise laboratory evaluation basis. These measurements, obtained from 2-inch sections cut from lower internodes of mature plants, provide a quantitative measure of stalk strength. Previous reports have concerned measurements for sections cut from the second or third internode (8, 17) or from the first extended internode above the soil (14). A better understanding of stalk strength as characterized by crushing strength and rind thickness would ensue if the comparative strengths of all internodes below the ear were known. The relation of plant spacing (plants per acre) to crushing strength and rind thickness would also contribute to a more complete understanding.

The purposes of this study were to measure stalk internodes of corn (Zea mays L.) below the ear for crushing strength, rind thickness, internode diameter, and internode length, to ascertain the comparative worth of the internode measurements in breeding for stalk strength, to relate plant spacing to crushing strength, rind thickness and stalk lodging, and to examine variance components relating to crushing strength and rind thickness.

LITERATURE REVIEW

Most studies have shown that corn plants have more broken stalks in close spacings than in wide spacings. Those observations were reported by Bryan et al. (1), Stringfield and Thatcher (13), Zuber and Grogan (16, 17), Dungan et al. (3), and Colville and McGil (2). Rounds et al. (12), however, found no consistent effect of rate and method of planting on stalk lodging. Although most reports concerned spacings of 8 to 20,000 plants per acre, 2 studies involved rates of over 20,000 plants per acre (2, 13).

Durrell (4) recorded breaking strength of the first 5 nodes above the ground and found that strength decreased successively from lower to higher nodes. The first 5 nodes of healthy stems had approximately twice the strength of the fourth nodes and lower nodes had more lignification than upper nodes. McRostie and McLachlan (9) determined strength by breaking, crushing, and to examine variance components relating to crushing strength and rind thickness.

MATERIALS AND METHODS

Data were obtained during 1960, 1961, and 1962. Two locations (Rocky Mount and Raleigh, locations 1 and 2, respectively) were utilized in each of the 3 years and 2 additional locations (Lewiston and Wallace) were used in 1960. All locations were in the Coastal Plain of North Carolina. The first extended internode above the soil was measured for crushing strength and rind thickness (locations 1 and 2, 1960); Study B, the first extended internode above the soil was measured for crushing strength and rind thickness (locations 1 and 2, 1960, 1961, and 1962); Study C, data from Study B plus similar data from the 2 additional locations in 1960.

Two additional studies consisted of crushing strength and rind thickness measurements of the first extended internode above the soil for 2 synthetic populations. Means have been reported previously (14) but components estimated from analyses of variance are identified herein as Study D (4 locations and 2 years) and Study E (4 locations). Both were randomized complete block designs.

Experimental designs for Studies A, B, and C were split plots in 3 replications with 4 spacings as whole plots and 10 hybrids as subplots. Spacings were approximately 6.1, 12.7, 18.3, and 24.000 plants per acre. Each subplot was 1 row 4C feet long with single plant hills. Mature plants were cut at ground level in each plot and dried. In Study A, one 2-inch section was cut from each internode below the ear. For convenience internodes were numbered downward with the first internode below the ear as one. The average number of plants per plot measured for each internode was 6.2 for internodes 1 through 5, 4.7 for internode 6, and 2.5 for internode 7. The reduced number of plants for internodes 6 and 7 was a consequence of removing internodes from the ear downward.

Crushing strength, rind thickness and internode diameter were determined from 2-inch sections cut from each internode. Procedures of Zuber and Grogan (17) were used for crushing strength and rind thickness. Internode length was determined for an average of 2.7 plants per plot selected at random. The first extended internode above the soil was measured for crushing strength and rind thickness at all locations. For Studies B and C, an average of 8.2 plants per plot were measured.