Chemical Composition of Tobacco Leaves as Affected by Soil Moisture Conditions

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In the various tobacco-producing areas of the world, the experience prevails that the general quality of tobaccos differs considerably from season to season, conditions other than the weather being the same. Although not responsible to the full extent, the availability of soil moisture to the plant has been held accountable for such effects as were noted and a review of available experimental data substantiates this viewpoint.

It is now generally accepted that the primary factor in soil-plant water relations are the forces with which water is held by the soil. Various methods are used to express the magnitude of these forces. Probably the best mode of expression is the amount of work that is done if one gram of chemically pure water is transferred from the soil to free water at the same elevation and temperature. The unit of measure is then ergs/g and the sign always negative. A more practical mode is obtained by assuming the density of water to be unity and gravity to be uniform, expressing then the work per gram as its numerical equivalent in the pressure exerted by a water column of stated height. Since the amount of work has a negative sign, the pressure has a negative sign also and one speaks generally of stress. Of course, one may also express the magnitude of the stress in cm of mercury or in (normal) atmospheres. Often the word "tension" is used instead of "stress", which is not quite correct, but makes little difference in most cases. For a full discussion, the reader is referred to Richards and Wadleigh (13).

The stress of soil moisture in drained soil may vary from 0 to 20 or 30 atmospheres. However, beyond a stress value of approximately 15 atmospheres, plants are generally not able to extract water in sufficient quantities to maintain existence. As a result they wilt and die. Under ordinary conditions the minimum stress is approximately 0.1 atmosphere, water that is held with less force being subject to rapid removal by gravity.

Most, if not all, of the existing literature on the tobacco plant and soil moisture does not use the energy concept of soil moisture and can only be approximately interpreted in that way. Nonetheless, valuable information has been accumulated up to date on the interrelation between soil moisture stress and the chemical composition of tobacco leaves.

In view of the increased interest in the control of soil moisture by means of supplemental irrigation, there may be merit in summing up the evidence available as of today and comparing it with results obtained in irrigation experiments with flue-cured tobacco conducted in North Carolina.

Conditions between different seasons. The results of such studies is restricted owing to the fact that different years other factors than soil moisture were also unequal. Such factors might be, for instance, intensity, air temperature and humidity, as well as the general management practices involved in the crop. Moreover, the recorded amounts of precipitation, but a poor indicator of soil moisture conditions, with Van Bavel (15)).

Darkis et al. (3, 4, 5) presented three subject, containing a thorough review of the literature. In the first one of these (3) it was mentioned that excessive rainfall produced thin, light-colored tobaccos, of increased carbohydrate content and percentage of nicotine, petrol ether extract, etc., nitrogen, as well as a reduction in the percentage of nitrogen which is soluble. Deficient rainfall resulted in hard, gummy, dark colored tobacco of decreased content, greatly increased nicotine... These conclusions were based on analyses of flue-cured tobacco of a variety of locations.

In a following paper (4) analyses of tobacco as Durham type (Middlebelt type, variety C 9), one location over a number of years were reported. The conclusion was that "...a wet season, which produces a light-bodied tobacco of lug character, will retard carbohydrate and potassium content and pH decreases in the remaining constituents... the smaller the supply of moisture the smaller the amount taken up and the greater the amount of nicotine..." The nicotine and nitrogen content were in some cases as 30% lower in wet years compared with dry ones.

In a third paper (5), Darkis et al. reported the composition of tobacco over a number of years, particularly the results obtained from tobacco-limed soils with those from unlimed soils from winter oats-soybeans-winter wheat-weeds rotated N. C. As to effects of weather conditions, it was noted as in the previous paper (4), and it was found to accentuate the undesirable effects of the weather, probably as a result of greater available nitrogen in the soil.

Recently, Renier (12) published a survey on weather conditions and chemical composition in France. From this study one may conclude a significant correlation between the nicotine content and the weather conditions (radiation and rainfall).