RESEARCH NOTE

GENETIC DIVERSITY FOR ALKALINITY NUMBER OF WATER SOLUBLE ASH

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Differences between flue-cured and burley tobacco types of *Nicotiana tabacum* L. arise from genetic factors and from cultural practices. A major difference in genetic composition is a one or two factor difference at the yb loci. Burley varieties are $yb_1yb_1yb_2yb_2$ and flue-cured varieties are usually $Yb_1Yb_1Yb_2Yb_2$ (12). The double recessive condition of burley varieties causes the plants to have a lower chlorophyll content than is present in flue-cured varieties. Burley tobacco is grown with higher amounts of nitrogen than flue-cured and it is air-cured as contrasted to the controlled temperature curing of flue-cured tobacco.

Flue-cured and burley tobacco consistently differ in alkalinity number of water soluble ash. Although techniques for measuring alkalinity number differ among research laboratories, experiments utilizing a procedure similar to that described by Moseley (9) show that the % ash and the alkalinity number of water soluble ash of flue-cured tobacco are about one-half as large as the values obtained from burley tobacco (e.g. 1, 2, 7, 9, 10, 11, 15). Alkalinity of water soluble ash is a measure of the potassium present in the leaf tissue in combination with organic acids which ashes to the carbonate. It reflects the burning characteristics of the leaf, a higher value indicating freer burn.

Comparisons of the two tobacco types are confounded by the chlorophyll deficiency of burley and by the cultural and curing differences. If one attempts to evaluate genetic potential of the two types by growing them together under either flue-cured or burley conditions, difficulties are encountered because burley tobacco grown with flue-cured cultural practices makes very little growth, whereas flue-cured tobacco grown under burley conditions is still growing rapidly at the end of the season and does not mature normally.

In an attempt to gain further knowledge concerning the mechanism of differences in alkalinity of water soluble ash between the two tobacco types, flue-cured cultivar 'SC58' was crossed to a burley cultivar 'Ky16' and backcrossed to SC58 for three generations. Between each backcross cycle, a generation of self-fertilization was employed to allow selection of the yb_1 and yb_2 alleles. This provided a line which had the characteristic chlorophyll deficiency of burley tobacco but a majority of the remaining germ plasm was expected to have been recovered from SC58.

This converted flue-cured variety, yb SC58, was crossed with 'Burley 21' and a breeding line, Greenville 63-486. The two F_1 hybrids, yb SC58, and the two burley varieties were grown at Waynesville, N. C. in 1968. Since yb SC58 was of genetic constitution $yb_1yb_1yb_2yb_2$, it gave the general appearance of a burley variety in the field as a variety *per se* and in F_1 hybrid combinations with the burley varieties. Air-cured leaves from two replications were subjected to ash analyses as described by Moseley (9). Data for % ash and alkalinity number of water soluble ash are presented in Table 1.

No differences existed among the entries for % ash. This suggests that the differences normally observed between flue-cured and burley tobacco may be 1) related to differences in cultural practices of the two types of tobacco, 2) a function of the yb loci, or 3) due to insufficient backcrossing to recover the functional alleles from SC58. At least flue-cured variety SC58, containing the yb_1 and yb_2 alleles, when grown under burley conditions did not differ from the two burley lines in % ash.

Large differences did exist among the entries for alkalinity number of water soluble ash. Since all entries contained $yb_1yb_1yb_2yb_2$, the average difference between burley and flue-cured tobacco for alkalinity number is not primarily a function of alleles at the two loci governing chlorophyll content of the leaves. Likewise, since all entries were grown under burley conditions and air-cured, the differences in the entries are not primarily due to cultural practices.

The primary difference among entries for alkalinity number appears to be related to diversity of burley and flue-cured germ plasm at loci other than the yb loci. The alkalinity number of yb SC58 was approximately one-half that of the burley varieties. This difference is of the same magnitude as that obtained for comparisons between normal commercially produced flue-cured and burley tobacco (op. cit). It is further noted that the F_1 hybrids between yb SC58 and the two burley varieties yield about the same alkalinity number as yb SC58. Thus, for this particular flue-cured variety, the genetic factors for low alkalinity number from the flue-cured variety predominate in the hybrids.

A previous study (15) showed that there is a large range in alkalinity number within the species *Nicotiana*. The range for seven species grown in a single experiment with flue-cured conditions was from 6.9 in *N. rustica* and *N. glauca* to 73.5 for *N. otophora*. In that experiment SC58 had a value of 25.5, similar to the present study. A study of six commercial flue-cured varieties showed small, but significant, differences for alkalinity number (4).

Cultural practices are also known to affect alkalinity number. Burley tobacco has been subjected to various methods of priming and application of supplemental heat during curing. Burton and Wright (3) found that certain of these treatments altered alkalinity number

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Table 1. Ash Content and Alkalinity No. Water Soluble Ash.

Genetic Entry	% Ash	Alkalinity No. Water Soluble Ash
Burley 21	21.40	50.6
Gr. 63-486	20.26	69.0
yb SC 58	19.74	25.1
Burley 21 x yb SC 58	20.10	18.0
Gr. 63-486 x yb SC 58	20.22	29.4
LSD .05	NS	10.2
.01	NS	16.0
CV	3	10

NS *Entries not different at 5% level of probability.*

whereas Atkinson (1) found no differences among the treatments. Various applications of potassium fertilizers affected alkalinity number of burley tobacco (2) and of flue-cured tobacco (6). Fertilizer chlorine levels (11) and urea applications (8) also affected alkalinity number. Alkalinity number varied with maturity at harvest (14) and with stalk position (13) in flue-cured tobacco, while in a separate study it was not affected by maturity (10). Applications of maleic hydrazide may alter alkalinity number (5,9). In most cases the changes in alkalinity number following application of cultural variables have been small compared with the difference between the flue-cured and burley varieties evaluated in this study under common cultural conditions.

The observations made in this study need to be expanded to a larger sample of burley and flue-cured germ plasm. At the present time the yb_1 and yb_2 alleles are being introduced into additional flue-cured varieties. Subsequent studies of segregating populations from flue-cured x burley crosses are needed to elucidate the genetic mechanism of alkalinity number of water soluble ash. The object of such studies would be to provide additional knowledge of the genetics of the tobacco plant. The authors do not suggest that flue-cured or burley tobacco would necessarily be benefited by a shift in alkalinity number of water soluble ash away from the norm for the respective types.

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