7-1965

Burley 49; A New Disease-Resistant Burley Tobacco

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BULLETIN 395 *JULY 1965*

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SUMMARY

BURLEY 49 is a stand-up type burley tobacco variety. It is highly resistant to black root rot, resistant to blackshank, wildfire, and mosaic, and somewhat resistant to fusarium wilt. Burley 49 is the first tobacco variety with black root rot resistance from the related species, **Nicotiana debneyi.**

Leaf yields of Burley 49 have been slightly higher than those of Burley 37 when grown on soils considered free of disease organisms. Under these conditions leaf quality of Burley 49 is slightly lower than that of Burley 37. Major cigarette manufacturing companies have indicated that the quality of Burley 49 leaf meets trade requirements.

This new variety is recommended primarily to growers anticipating losses from blackshank and black root rot.

ACKNOWLEDGMENT

Grateful acknowledgment is made to J. Hugh Felts, Superintendent, Tobacco Experiment Station, Greeneville, Tennessee, for assistance in conducting the experimental work; to R. J. Reynolds Tobacco Co. for financial support; to American Tobacco Co., R. J. Reynolds Tobacco Co., Liggett and Myers Tobacco Co., Brown and Williamson Tobacco Co. and Philip Morris, Inc. for leaf quality evaluations; to superintendents of branch stations and cooperating growers for conducting yield tests, and to D. R. Bowman, Plant Physiologist, Crops Research Division, Agricultural Research Service, Knoxville, Tennessee.

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THE wildspread distribution of blackshank[1] has limited many growers to varieties that are resistant to this disease. Burley 37 usually gives adequate protection from blackshank, but it is often severely damaged by black root rot[2]. Burley 49, a recently developed variety, combines the blackshank resistance of Burley 37 with a high level of black root rot resistance. It is also resistant to wildfire[3], tobacco mosaic[4], and somewhat resistant to fusarium wilt[5].

DESCRIPTION

Burley 49 plants are stand-up in type (Fig. 1). The leaves are short (Table 1), relatively broad, and closely spaced on a short stalk. This variety resists lodging and tends to hold its bottom leaves until harvest (Fig. 2).

Compared to Burley 37, Burley 49 produces about one more leaf per plant, requires 3 to 7 days longer from setting to flowering, and gains height more slowly. The short plants with short, upright leaves sometimes give this variety a deceptive appearance of being low yielding.

[1]Caused by **Phytophthora parasitica** (Dast.) var. **nicotianae** (Breda de Haan) Tucker.
[2]Caused by **Thielaviopsis basicola** (Berk. & Br.) Ferr.
[3]Caused by **Pseudomonas tabaci** (Wolf & Foster) F. L. Stevens.
[4]Caused by tobacco mosaic virus.
[5]Caused by **Fusarium oxysporum**, (Schlecht.) f. sp. **nicotianae** (J. Johnson) Snyd. & Hans.

Figure 1. Typical growth of Burley 49.

ORIGIN AND DEVELOPMENT

Burley 49 was developed at the Tobacco Experiment Station, Greeneville, Tennessee from a cross between two breeding lines, 57-237 and 57-409. Line 57-237 was similar to Burley 37 (5) and closely related to it. In addition to desirable agronomic traits, line 57-237 contributed genes for disease resistance. These included blackshank resistance from the Florida 301 variety which has been transferred to burley by a series of crosses (4,5), wildfire resistance originally from **Nicotiana longiflora** Cav. (3), and some tolerance to fusarium wilt which presumably came from a progenitor of Burley 11A (4). Line 57-409 also had the gene for wildfire resistance from **N. longiflora.** In addition, it contributed

Table 1. Certain plant characteristics of Burley 49 and Burley 37, 2-year averages, 1963-64

	Shortly before Topping		Shortly before Harvest				
	Stalk Height in Inches	Leaf Number	Stalk Height in Inches	Leaf Number	Mid-Plant Leaf size in Inches		Internode Length in Inches
					Width	Length	
Burley 49	72.0	26.1	47.2	21.2	12.4	26.3	2.28
Burley 37	77.7	25.2	51.0	20.5	12.3	27.5	2.52
LSD (.05)	3.7	N.S.	2.0	N.S.	N.S.	0.8	0.13

Figure 2. Comparative holding of bottom leaves at maturity. Left to right: Kentucky 9, Burley 49, and the hybrid Male Sterile Burley 21 x Kentucky 10. Notice the upright leaves of Burley 49.

a dominant gene originally from **N. debneyi** Domin. conditioning high resistance to black root rot (1), the factor for mosaic resistance from **N. glutinosa L.**, and apparently some resistance to blackshank and fusarium wilt from a progenitor of Burley 11A. The three tobacco-related species which were sources of disease resistance of Burley 49 are shown in Figure 3.

Seed plants of each of the first six generations from the cross were grown in either a blackshank or a fusarium wilt nursery. Surviving plants were inoculated with the wildfire and mosaic pathogens. Seed was saved only from plants of desirable type which showed resistance to each disease. Progeny tests of the selected seed plants for resistance to black root rot, wildfire, and mosaic were conducted in the greenhouse in the winter seasons. Replicated leaf yield and quality tests were conducted on relatively disease-free soil concurrently with selection for disease resistance. From 1962 through 1964 Burley 49 was tested extensively as Greeneville 49A.

Burley 49 was derived from one selected plant in each of the F_1, F_2, and F_3 generations. Seed from several selected plants was

Figure 3. Three tobacco-related species which were original sources of disease resistance genes incorporated in Burley 49. Left to right: N. longiflora, N. debneyi and N. glutinosa. These species are sources of resistance to wildfire, black root rot and mosaic, respectively.

used to make up each of the later generations. This variety was in the F_5 generation of selfing when released for 1965 planting. Foundation seed is being produced on blackshank-infested soil to insure maintenance of the present level of blackshank resistance.

DISEASE RESISTANCE

Black Root Rot

The black root rot resistance of Burley 49 is conditioned by a single, dominant gene from **N. debneyi** (1). This gene gives a much higher level of resistance than is available in other varieties (Fig. 4), and has provided complete protection from black root rot under field conditions (Fig. 5). Burley 49 is the first tobacco variety with resistance to black root rot from **N. debneyi.**

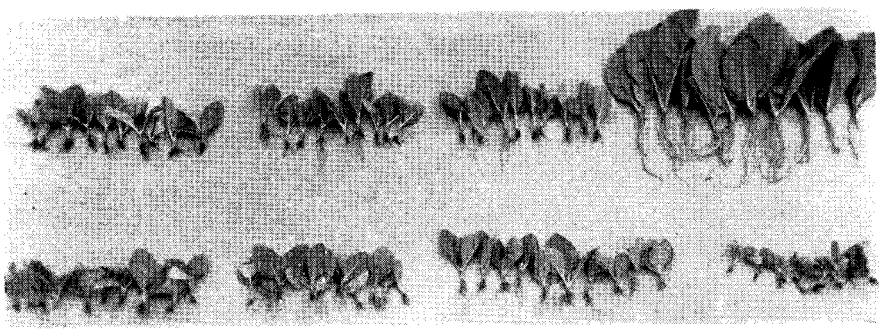

Figure 4. Influence of black root rot on the growth of eight varieties. Left to right, top row: Burley 1, Burley 21, Burley 37, Burley 49. Bottom row: Kentucky 9, Kentucky 10, Kentucky 12, Kentucky 16. Four-week-old seedlings were set in a greenhouse bed highly infested with the black root rot fungus, allowed to grow 1 month, dug, washed, and photographed.

Blackshank

Burley 49 has the same type of blackshank resistance as Burley 37. This resistance prevents major losses, but a few plants may die and others may be stunted when conditions favor blackshank. The level of resistance in a variety is thought to depend upon modifying genes (2). Burley 49 apparently has a favorable combination of such modifying genes.

The levels of blackshank resistance of Burley 49 and Burley

37 were compared at two locations in 1964. Both sites had a high incidence of the blackshank fungus. This is indicated by the high kill of the susceptible check variety, Burley 21 (Fig. 6). Survival percentages were calculated from plant counts made in June and October. These are shown in Table 2.

Surviving plants were dug and their roots examined for blackshank lesions to provide a more sensitive measure of resistance levels. All plants were grouped into one of five classes from 0, no apparent lesions, to 100, all roots diseased. Average values are shown in Table 2 under root index. These indicate that Burley 49 is more resistant to blackshank than Burley 37.

Figure 5. Comparative growth of three varieties in a black root rot nursery, Johnson County, Tennessee, August 23, 1963. Left to right: Burley 21, Judy's Pride (overgrown by weeds), and Burley 49. Both Burley 21 and Judy's Pride bloom before Burley 49 in the absence of this disease.

Figure 6. Testing Burley 49 for blackshank resistance. All plants in the center row which were Burley 21 have been killed by blackshank. The rows on either side of the center row are Burley 49.

Table 2. Response of Burley 49 and Burley 37 to high natural Infestation of the blackshank fungus at two locations, Greeneville, Tennessee 1964

Location and Variety	Original plant count	Survival percent	Root index*
Malone farm			
Burley 49	673	98.1	4.15
Burley 37	603	95.8	11.10
LSD (.05)		N.S.	5.18
Burley 21	287	0.0	
Hunter farm			
Burley 49	714	99.4	3.06
Burley 37	433	99.1	14.25
LSD (.05)		N.S.	3.62
Burley 21	218	8.7	

*0 = no apparent lesions; 100 = all roots diseased

Wildfire

Burley 49 has the same resistance to wildfire as Burley 21 and Burley 37 (3,5). This resistance usually gives satisfactory protection, but there are strains of the organism that can cause wildfire in plants with this resistance (6). Apparently these virulent strains are not widespread in the burley belt.

Mosaic

The mosaic resistance of Burley 49 is the same as that of Burley 21, Kentucky 10, and Kentucky 12. This resistance gives nearly complete protection under field conditions.

Fusarium Wilt

The fusarium wilt resistance of Burley 49 was compared in 1964 with the moderately resistant variety Burley 37 and the relatively susceptible variety Burley 21. Plant roots were washed free of soil and innoculated before transplanting into a fusarium wilt nursery. Survival percentages (Table 3) indicate the portion of plants surviving transplanting that remained in October without obvious fusarium wilt symptoms. These results indicate that Burley 49 is only moderately resistant to fusarium wilt. However, this level may be useful to growers choosing Burley 49 for its black root rot and blackshank resistance.

Table 3. Survival of three varieties inoculated with the fusarium wilt fungus before transplanting, Greeneville, Tennessee, 1964

Variety	Original plant count	Percent survival
Burley 49	753	36.5
Burley 37	469	23.2
LSD (.05)		N.S.
Burley 21	459	2.8

Other Diseases

Burley 49 is susceptible to two diseases which in the past have been considered to be of minor importance. Observations near Waynesville, North Carolina in 1963 and 1964 and at several

Tennessee locations in 1965 indicate that Burley 49 is more susceptible to weather fleck than Burley 37, which in turn is more weather fleck susceptible than most burley varieties. Field observations at Greeneville, Tennessee in 1964 suggest that Burley 49 is more susceptible to brownspot[6] than most popular varieties.

LEAF PRODUCTION

Acre Yield

Burley 49 was compared with Burley 37 at 8 Tennessee locations in 1962 and at 10 Tennessee locations in 1963 and 1964. Test sites were chosen to minimize the influence of diseases. The results in Table 4 show that Burley 49 is slightly higher-yielding than Burley 37 when diseases are unimportant.

Table 4. Average acre yield for Burley 49 and Burley 37 grown at 8 locations in 1962 and at 10 locations in 1963 and 1964

Variety	1962	1963	1964	Average
Burley 49	2504	2464	2774	2581
Burley 37	2433	2402	2733	2523
LSD (.05)				44

Leaf Quality

The leaf obtained in the yield tests was evaluated for quality. Because no measure of quality is completely satisfactory, three indicators are presented. These are grade index, dollars per hundredweight, and percentage that major cigarette manufacturing companies consider usable. Grade index reflects the traditional preference for certain grades when supplies are ample. It is based on average market values of the various government grades during the years 1934-35 and 1937-1940. Dollars per hundredweight is calculated from the average selling price of tobacco in the respective grades for the season in which the tobacco was grown. Percentage usable is more sensitive to the requirements of the leaf trade than either of the above indicators. However, this percentage cannot be converted into economic value.

Grade index, dollars per hundredweight, and percentage usable for Burley 49 and Burley 37 are shown in Table 5. Each of these show slightly lower values for Burley 49. Together they demonstrate that under the conditions of the tests Burley 49 produces slightly lower quality leaf than Burley 37.

[6]Caused by Alternaria longipes (Ell. & Ev.) Mason.

Table 5. Average grade index, dollars per hundredweight, and percentage usable for Burley 49 and Burley 37 grown at 8 locations in 1962 and at 10 locations in 1963 and 1964

Variety	1962	1963	1964	Average
		Grade Index		
Burley 49	0.650	0.586	0.547	0.594
Burley 37	0.644	0.591	0.571	0.602
LSD (.05)				N.S.
		Dollars per Hundredweight		
Burley 49	66.20	64.00	63.31	64.50
Burley 37	66.01	64.30	63.86	64.72
LSD (.05)				N.S.
		Percentage Usable		
Burley 49	55.0	32.8	38.8	42.2
Burley 37	66.5	39.4	40.8	48.9
LSD (.05)				4.6

Acre Values

The combined effect of yield and quality was estimated by calculating crop index and acre value. Crop index is the product of grade index times acre yield. Acre value is the product of dollars per hundredweight times yield. Crop index and acre value for Burley 49 and Burley 37 are shown in Table 6. These values show the similarity in performance of Burley 49 and Burley 37 when diseases are unimportant.

Table 6. Average crop index and acre value for Burley 49 and Burley 37 grown at 8 locations in 1962 and at 10 locations in 1963 and 1964

Variety	1962	1963	1964	Average
		Crop Index		
Burley 49	1644	1455	1499	1533
Burley 37	1580	1427	1537	1515
LSD (.05)				N.S.
		Acre Value in Dollars		
Burley 49	1660	1578	1758	1665
Burley 37	1608	1543	1751	1634
LSD (.05)				31

DISCUSSION

Burley 49 is recommended primarily where losses from black root rot and blackshank are expected. In the absence of these diseases, other varieties such as Burley 21 will probably prove superior to Burley 49. Yield and quality comparisons made under conditions where diseases had little effect showed that Burley 49 produces slightly higher yields of slightly lower quality leaf than Burley 37. In practice, Burley 49 should compare more favorably with Burley 37 because black root rot is widespread and often prevents Burley 37 from reaching its potential leaf yield and quality.

There is a high probability of black root rot damage when tobacco is raised on the same land continuously. Damage may also occur if the previous crop was a susceptible legume such as lespedeza, soybeans, or alfalfa. These losses are often tolerated because they are undetected. Even when black root rot is not suspected, growers practicing continuous burley tobacco culture or using black root rot susceptible legumes in their rotation may profit by growing a few rows of Burley 49 through the field. If black root rot is serious, the contrast between the uninhibited growth of Burley 49 and the retarded development of the rest of the crop will be obvious (Fig. 7).

Black root rot damage can be reduced or eliminated either by following a proper crop rotation or by growing Burley 49. Using a suitable crop rotation is often the preferred method because it helps maintain favorable soil structure and helps reduce the build-up of tobacco disease organisms and pests.

Although Burley 49 is more resistant to blackshank than Burley 37, some losses may occur on land highly infested with the blackshank organism. These losses can be eliminated or greatly reduced by rotating tobacco with other crops, preferably perennial grasses.

The growth habits of Burley 49 facilitate handling the crop. Its lodging resistance and upright leaf position reduce leaf breakage during field operations such as topping, suckering, and spraying. Upon cutting, the leaves tend to lie next to the stalk, minimizing leaf losses in handling. The shorter stalk should improve air circulation in curing barns by reducing the overlapping of tobacco from one tier to the next. The ability of Burley 49 to hold its bottom leaves will provide better opportunity to harvest a mature crop.

Figure 7. Differential growth of Burley 49 (left) and Burley 21 (right) due to black root rot. The grower did not know black root rot was affecting his crop until he observed the contrast between Burley 49 and Burley 21.

Under some conditions the late-maturing characteristics of Burley 49 may be a disadvantage. This is most important in mountainous areas having short growing seasons. However, when Burley 49 was topped on the same date as Burley 37, it appeared to mature almost as soon as Burley 37. Thus, early topping may be useful in hastening leaf maturity of Burley 49 where this is necessary.

Only limited results of Burley 49 performance outside Tennessee are available. The available results suggest that Burley 49 may be adapted to about the same areas as Burley 37 and that Burley 49 is less widely adapted than Burley 21.

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