

AGRIC. LIBRARY

NOV 27 1962

UNIV. OF TENN.

Burley 37, A Blackshank- And Wildfire- Resistant Burley Tobacco

•
H. A. SKOOG

M. O. NEAS

H. E. HEGGESTAD

•
BULLETIN 333

OCTOBER 1961



**The University of Tennessee
Agricultural Experiment Station
Knoxville
in cooperation with
Crops Research Division
Agricultural Research Service
U. S. Department of Agriculture**

SUMMARY

● Burley 37 has higher blackshank resistance than the other two commercially-available blackshank-resistant varieties, Burley 11-A and Burley 11-B. It also has wildfire resistance and stand-up leaf characteristics which are improvements over those of Burley 11-A and Burley 11-B. Burley 37 does not have as high a resistance to fusarium wilt or black root rot as Burley 11-A and Burley 11-B. Because Burley 37 is resistant and not immune from these root diseases, it is recommended that the variety be grown in rotation with other crops.

● Yield, quality, and acre value of Burley 37 have been satisfactory in tests conducted on soil considered free of tobacco pathogens. Acre returns, yield, and quality of Burley 37 have been less than those of Burley 21, but the variety has been judged acceptable by cigarette manufacturers.

● Burley 37 is recommended for areas in the Burley Belt where blackshank is prevalent.

ACKNOWLEDGMENT

Grateful acknowledgment is hereby made by the authors to Station Superintendents J. Hugh Felts, Tobacco Experiment Station, Greeneville, Tenn.; John Odom, Plateau Experiment Station, Crossville, Tenn.; E. J. Chapman, Middle Tennessee Experiment Station, Spring Hill, Tenn.; Lawson M. Safley, Highland Rim Experiment Station, Springfield, Tenn.; and the cooperative growers for assistance in conducting the experiments.

CONTENTS

	Page
SUMMARY	2
INTRODUCTION	4
DESCRIPTION	4
ORIGIN AND DEVELOPMENT	7
DISEASE RESISTANCE	8
Blackshank	8
Black Root Rot	10
Fusarium Wilt	10
Wildfire	11
STRAINS OF PATHOGENS	11
YIELD AND QUALITY	12
LITERATURE CITED	15

Burley 37, A Blackshank - And Wildfire - Resistant Burley Tobacco

H. A. Skoog

Research Agronomist, Greeneville, Tenn.

M. O. Neas

Agricultural Aide, Greeneville

H. E. Heggestad

Principal Agronomist, Beltsville, Md.
(formerly of Greeneville)

Burley 37, a newly-developed variety of burley tobacco resistant to blackshank¹ and wildfire², was released jointly by the University of Tennessee Agricultural Experiment Station and the United States Department of Agriculture in January 1960. Burley 37 also has moderate resistance to black root rot³ and fusarium wilt⁴. It has characteristics that are improvements over those of the only other commercially-available, blackshank-resistant varieties, Burley 11-A and Burley 11-B. The new tobacco is the first commercially-available variety with the combined resistance to wildfire and blackshank.

DESCRIPTION

Burley 37 is of the stand-up type and in the field resembles the widely-grown variety Burley 21 (Fig. 1). The leaves of Burley 37 are wider than those of Burley 21, but are shorter (Table 1). This new variety blooms about 3 days later than Burley 21 (Table 2). Burley 37 has more leaves than Burley 11-A and fewer than Burley 21. Topped plants of Burley 37 averaged about 23 leaves or about the same as for Burley 21 (Table 2). More detailed information on leaf size (Table 1) and plant characteristics (Table 2) follows.

1. Caused by *Phytophthora parasitica* Dast. var. *nicotianae* (Breda de Haan) Tucker

2. Caused by *Pseudomonas tabaci* (Wolf & Foster) F. L. Stevens

3. Caused by *Thielaviopsis basicola* (Berk & Br.) Ferr.

4. Caused by *Fusarium oxysporum* Schlecht. f. sp. *nicotianae* (J. Johnson) Snyder & Hans.



Figure 1. Comparative plant types of three tobacco varieties showing differences in leaf angle at day of harvest. Top to bottom: Burley 11-A, Burley 37, and Burley 21, Greeneville, Tenn., 1959.

Table 1. Average Leaf Measurements (inches) at Different Leaf Positions of Burley 37 and Burley 21 Tobacco, Greeneville, Tenn., 1957-1959.*

Variety and year	Before topping						After topping			
	$\frac{1}{4}$ plant height		$\frac{1}{2}$ plant height		$\frac{3}{4}$ plant height		Midleaf		2nd from top	
	Width	Length	Width	Length	Width	Length	Width	Length	Width	Length
Burley 37:										
1957	16.4	27.5	12.3	25.8	8.7	17.7	12.1	25.2	10.7	20.1
1958	16.1	28.6	13.1	25.4	11.1	19.7	—	—	—	—
1959	14.6	27.0	13.0	26.7	10.9	20.3	11.8	25.5	9.9	20.1
Average	15.7	27.7	12.8	26.0	10.2	19.2	11.9	25.4	10.3	20.1
Burley 21:										
1957	14.8	28.0	11.8	27.1	8.2	18.6	11.1	27.9	9.8	23.1
1958	14.1	29.2	12.1	25.9	10.0	22.5	—	—	—	—
1959	15.5	27.2	12.9	27.9	9.9	21.4	11.8	27.1	9.4	22.0
Average	14.8	28.1	12.3	27.0	9.4	20.8	11.5	27.5	9.6	22.6

* Based on measurements of 10 plants.

Table 2. Plant Characteristics of Burley 37 and Burley 21 Tobacco, Greeneville, Tenn., 1957-1959.

Variety and year	Leaf number*		Days to bloom
	Before topping	After topping	
Burley 37:			
1957	26.7	22.6	63
1958	24.3	—	72
1959	26.7	23.8	62
Average	25.9	23.2	66
Burley 21:			
1957	27.1	22.2	61
1958	28.2	—	68
1959	27.1	22.8	60
Average	27.5	22.5	63

* Based on counts of 10 plants.

ORIGIN AND DEVELOPMENT

Burley 37 originated from a cross between Greeneville 25 and Greeneville 42 at the Tobacco Experiment Station, Greeneville, Tenn., in 1952. Greeneville 25 is the progenitor of Burley 21. Burley 11-A and Burley 11-B resulted from selections of Greeneville 42. The pedigree of Burley 21 was presented by Heggstad, Clayton, Neas, and Skoog (2). The development of Burley 11-A and Burley 11-B was discussed by Heggstad and Neas (1).

Greeneville 25, one of the parents of Burley 37, was a stand-up type, moderately resistant to black root rot, which carried the necrotic-lesion type of tobacco mosaic resistance originating from *Nicotiana glutinosa* L., and wildfire resistance from *N. longiflora* Cav. The leaves of Greeneville 42 were drooping and the line was early in maturity. Greeneville 42 had moderate to good blackshank resistance, good black root rot resistance, and good resistance to fusarium wilt.

The plants from the original cross were grown in the greenhouse during the winter of 1952-1953. Beginning in the summer of 1953, all generations were advanced in the field. Emphasis in selection was on upright leaf habit and resistance to diseases, particularly blackshank and wildfire. Several sister lines were carried along at the same time.

Inoculations were made with tobacco mosaic virus, but plants that displayed other desirable characteristics, even though they were susceptible to this pathogen, were not eliminated. Inocu-

lations were made with wildfire bacteria both in the plant bed and the field. Some sister lines of Burley 37 retained mosaic resistance, but the superiority of Burley 37 in other respects, including acceptance for smoking flavor, narrowed the selection to this line. Beginning in 1958 and until release, Burley 37 was tested as Greeneville 37.

DISEASE RESISTANCE

Blackshank

As previously mentioned, Burley 37 is a cross between progenitors of Burley 21 and Burley 11-A. It has higher blackshank resistance than Burley 11-A and Burley 11-B. Burley 21 is susceptible to blackshank (1) even though the wild species *Nicotiana longiflora* was used in its parentage. *N. longiflora*, which is highly resistant to blackshank, was the source of wildfire resistance in Greeneville 25 and Burley 21.

Continuous selection for blackshank resistance has been followed annually for several years. Seed was harvested only from those plants of Burley 11-A and Burley 11-B with high resistance to blackshank; but even with this selection Burley 37 has higher resistance than either of the other varieties.

There is a slight possibility that the original parent plant of Greeneville 42 used for the cross was more highly resistant than other plants in the breeding line, but another theory appears more probable to explain the high level of blackshank resistance in Burley 37. Clayton (3) stated that better success had been obtained in breeding for blackshank resistance in burley than in the Orinoco type of tobacco. It is entirely possible that the susceptible parent, Greeneville 25, contributed inheritable factors to the cross which made Burley 37 more resistant than its resistant parent, Greeneville 42.

A method believed to be of considerable importance contributing to the success in developing high resistance in burley tobacco varieties is the close examination and classification of roots of seed plants grown in heavily-infested soil (Fig. 2). All plants were critically examined late in the season at time of seed harvest, and all except the most resistant ones were discarded.

Plant survival of Burley 37 in blackshank-infested soil for the 3-year period 1957-1959 was superior to that of Burley 11-A each year. As essentially similar results were obtained in all 3 years, only the data from 1959 are presented (Table 3). These



Figure 2. Comparative growth of three tobacco varieties in the presence of blackshank on the Malone Farm. Left to right: Burley 37, Burley 21, and Burley 11-A, Greeneville, Tenn., 1959.

data were obtained from two plots mentioned in another publication (1). The incidence of the disease in these two plots is reflected in the complete kill of a susceptible variety, Burley 21, as indicated in Table 3.

Table 3. Survival of Three Varieties of Tobacco in Blackshank-infested Soils, Greeneville, Tenn., 1959.

Place and variety	Original stand plants	Survival percent
Malone farm:		
Burley 37	300	98.3
Burley 11-A	264	78.4
Burley 21	245	0.0
Hunter farm:		
Burley 37	236	93.6
Burley 11-A	241	86.3
Burley 21	240	0.0

In these plots Burley 37 was more vigorous than Burley 11-A and its roots had less extensive symptoms of the disease. A disease index was obtained from surviving plants of each of the two varieties on the Malone farm in 1959. The plants had been selected for type and vigor and had been bagged for possible seed harvest. The roots were classified 0, 1, 2, 3, or 4 depending upon the extent of disease injury. As an index of zero would indicate no disease symptoms, the lower average represents higher resistance. The index for Burley 11-A was 72.0 and that for Burley 37 was 52.5.

Black Root Rot

Black root rot has been a problem to many tobacco growers in the burley-producing area. More black root rot has been observed in recent years, especially in fields continuously cropped to tobacco. Cultural practices can be followed to minimize losses from black root rot, but resistant varieties are also effective. There are different methods used to evaluate resistance to this disease; the method used to obtain the data for Table 4 will be the only one discussed.

The procedure followed was to germinate seeds in sterilized soil and transplant small seedlings into infested soil in greenhouse benches. The plants were allowed to grow for approximately 4 weeks at cool temperatures, and then dug, and the roots were washed and classified. The indexes were obtained in a manner similar to that described for the blackshank indexes except for making the readings on small plants in the greenhouse in winter. The data indicate that Burley 37 is about equal to Burley 21 in black root rot resistance; Burley 11-A has higher resistance than the other two varieties.

Table 4. Black Root Rot Disease Indexes of Three Burley Tobacco Varieties, Greeneville, Tenn., 1957-1959.

Variety	1957	1958	1959	Average
Burley 37	59	63	67	63
Burley 21	45	75	67	62
Burley 11-A	30	—	58	44

Fusarium Wilt

In certain areas where burley tobacco is produced, fusarium wilt is troublesome and good use is made of resistant varieties.

Burley 11-A, as well as Burley 11-B and Kentucky 35, has considerable resistance to this disease. Burley 21 has a low level of resistance to fusarium wilt. Testing for resistance to this disease was carried on by inoculating plants at time of transplanting.

Burley 37 is between Burley 21 and Burley 11-A in fusarium wilt resistance (Table 5). These figures represent the percent surviving plants based upon counts made when the plants were adjudged to have survived transplanting and again just before seed harvest. Plants showing obvious symptoms of the disease at the latter period were not considered survivors. Data on selections that composed Burley 37 were used for the 1957 figure. In 1957 and 1958, data were based on single plots of 50 transplants. Two plots of 50 transplants each provided the data for 1959. Burley 2 was included as a susceptible check.

Table 5. Percent Survival of Four Burley Varieties of Tobacco Inoculated with the Fusarium Wilt Organism, Greeneville, Tenn.

Variety	1957	1958	1959	Average
Burley 37	75	72	56	68
Burley 11-A	89	91	92	91
Burley 21	—	21	26	24
Burley 2	4	2	0	2

Wildfire

Wildfire resistance of Burley 37 is the same as for Burley 21. Burley 11-A is susceptible. This bacterial disease has recently been observed to a limited extent on Burley 21, and, as Burley 37 has the same type of resistance, some wildfire may appear on it. Under most conditions the resistance should be adequate to give protection from wildfire losses in plant beds and fields.

STRAINS OF PATHOGENS

Strains of the above-mentioned pathogens are known to exist or have been reported. Because Burley 37 has resistance and not immunity from these four diseases, the recommendation is that this variety be grown in rotation with other crops. Crop rotation will aid in preventing the build-up of disease organisms and new strains of the pathogens should be less likely to occur.

YIELD AND QUALITY

Disease resistance in tobacco is of great importance to many growers. However, a new variety should also be compared in yielding ability and quality with other standard varieties under relatively disease-free conditions.

Burley 37 was tested for 3 years at various locations in the absence of any major tobacco pathogens. The experimental design was randomized blocks with four replications at each location. Individual 1/100-acre plots were harvested. The tobacco was cured and stripped by the growers. Later the tobacco was classified by federal graders.

Quality can be evaluated by more than one method. In Tables 6 and 7 the grade-index system was used. This system is based on relative prices received for burley tobacco grades in the marketing years 1934, 1935, 1937, 1938, and 1939. It has the advantage that these calculated values can be used to compare tobacco grown in different years. Usage by the tobacco companies may vary over a period of years and the index system does not reflect such changes. Yield, grade index, and crop index for Burley 37 are shown in comparison with those for Burley 2 and Burley 21 grown at 10 locations in 1957 (Table 6). The following year Burley 11-A was substituted for Burley 2 as one of the check varieties so that the advanced lines with blackshank resistance could be compared with a standard blackshank-resistant variety. Also included for 1958-1959 are the acre values for the varieties, an evaluation of considerable importance to the grower (Table 7).

There were no significant differences among Burley 2, Burley 21, and Burley 37 in 1957 (Table 6). For the 1958-1959 seasons Burley 37 ranked above Burley 11-A and below Burley 21 in yield, crop index, and acre value. The differences were all highly significant on the basis of the averages for the 8 locations. In grade index Burley 11-A was significantly better than Burley 37, and Burley 21 was better than Burley 11-A. The difference between Burley 21 and Burley 37 was highly significant.

Tobacco grown in these test plots was also evaluated by three major cigarette manufacturing companies for acceptability. Burley 37 was found acceptable for smoking flavor, chemical constituents, and physical characteristics.

Table 6. Average Yields, Grade Indexes, and Crop Indexes for Three Varieties of Tobacco at 10 Locations, 1957.

Variety	Rutherford farm, Sulli- van Co.	Street Farm, Washing- ton Co.	Tobacco Exp. Sta., Greene Co.	Gaby farm, Greene Co.	Owens farm, Cocke Co.	Moser farm, Jeffer- son Co.	Bettis farm, Loudon Co.	Plateau Exp Sta., Cumber- land Co.	Middle Tenn. Exp Sta., Maury Co.	Highland Rim Exp. Sta., Robert- son Co.	Av.
	Yield (pounds/acre)										
Burley 2	2005	2935	2078	1979	2414	1962	1753	1911	2011	2529	2158
Burley 21	1804	2978	2246	2011	2341	1884	1614	1869	1906	2450	2110
Burley 37	1952	3202	2220	1995	2329	1895	1846	2037	1996	2414	2189
										L.S.D. at .05	NS
	Grade index										
Burley 2	.687	.508	.556	.674	.458	.495	.432	.523	.512	.612	.546
Burley 21	.621	.500	.590	.557	.441	.438	.425	.530	.512	.576	.519
Burley 37	.602	.532	.642	.608	.403	.432	.470	.502	.461	.583	.524
										L.S.D. at .05	NS
	Crop index (yield x grade index)										
Burley 2	1379	1483	1160	1346	1107	972	760	1010	1026	1548	1179
Burley 21	1124	1489	1336	1153	1035	832	688	1006	979	1412	1105
Burley 37	1182	1700	1426	1231	940	820	874	1028	916	1411	1153
										L.S.D. at .05	NS

Table 7. Average Yields, Grade Indexes, Crop Indexes, and Acre Values for Three Varieties of Tobacco at Eight Locations, 1958-1959.

Variety	Street farm, Washing-ton Co.	Tobacco Exp. Sta., Greene Co.	Owens farm, Cocke Co.	Moser farm, Jefferson Co.	Bettis farm, Loudon Co.	Plateau Exp. Sta., Cumberland Co.	Middle Tenn. Exp. Sta., Maury Co.	Highland Rim Exp. Sta., Robin-son Co.	Av.
Yield (pounds/acre)									
Burley 37	2872	2050	1860	2276	2163	1745	1691	1771	2054
Burley 11-A	2326	1709	1819	2086	2109	1721	1477	1714	1870
Burley 21	2847	2079	2268	2414	2415	1858	1815	2066	2220
								L.S.D. at .05	56
								L.S.D. at .01	75
Grade index									
Burley 37	.634	.604	.631	.559	.452	.507	.551	.589	.566
Burley 11-A	.661	.599	.640	.619	.452	.517	.536	.670	.587
Burley 21	.685	.606	.683	.610	.447	.515	.558	.659	.595
								L.S.D. at .05	.018
								L.S.D. at .01	.024
Crop index (yield x grade index)									
Burley 37	1846	1232	1181	1270	1009	886	948	1058	1179
Burley 11-A	1551	1009	1162	1297	1003	901	802	1161	1111
Burley 21	1969	1258	1553	1467	1163	966	1047	1377	1350
								L.S.D. at .05	56
								L.S.D. at .01	75
Acre value (dollar/acre)*									
Burley 37	1937	1373	1253	1501	1359	1134	1133	1208	1362
Burley 11-A	1563	1137	1224	1389	1340	1130	981	1182	1243
Burley 21	1928	1388	1539	1599	1508	1211	1209	1415	1475
								L.S.D. at .05	41
								L.S.D. at .01	54

* Calculations are based on market averages by grades for each season.

LITERATURE CITED

1. Heggstad, H. E., and Neas, M. O.

The disease resistant varieties Burley 11-A and Burley 11-B and observations on tobacco blackshank in Tennessee. Tenn. Agric. Expt. Sta. Bul. 261. 1957.

2. Heggstad, H. E., Clayton, E. E., Neas, M. O., and Skoog, H. A.

Development of Burley 21, the first wildfire-resistant variety, including results of variety trials. Tenn. Agric. Expt. Sta. Bul. 321. 1960.

3. Clayton, E. E.

The genetics and breeding progress in tobacco during the past 50 years. Agron. Jour. 50: 352-356. 1958.

THE UNIVERSITY OF TENNESSEE AGRICULTURAL EXPERIMENT STATION KNOXVILLE, TENNESSEE

Agricultural Committee Board of Trustees

ANDREW D. HOLT, *President*

CLYDE M. YORK, *Chairman*

BEN DOUGLASS, HARRY W. LAUGHLIN, WASSELL RANDOLPH

W. F. MOSS, *Commissioner of Agriculture*

Station Officers

ADMINISTRATION

ANDREW D. HOLT, President

WEBSTER PENDERGRASS, Dean of
Agriculture

J. A. EWING, Director

ERIC WINTERS, Associate Director

FLORENCE L. MACLEOD, Assistant
Director, Home Economics
Research

J. L. ANDERSON, Budget Officer

DEPARTMENT HEADS

T. J. WHATLEY, Agricultural
Economics and Rural Sociology

J. H. ANDERSON, Agricultural
Engineering

L. F. SEATZ, Agronomy

C. S. HOBBS, Animal Husbandry-
Veterinary Science

J. T. MILES, Dairy

M. R. JOHNSTON, Food Technology

B. S. PICKETT, Horticulture

R. L. HAMILTON, Information

K. L. HERTEL, Physics

J. O. ANDES, Plant Pathology

O. E. GOFF, Poultry

University of Tennessee Agricultural Research Units

Main Station, J. N. ODOM, General Superintendent of Farms, Knoxville
University of Tennessee-Atomic Energy Commission Agricultural
Research Laboratory, Oak Ridge, N. S. Hall, Laboratory Director

Branch Stations

Dairy Experiment Station, Lewisburg, J. R. OWEN, Superintendent

Highland Rim Experiment Station, Springfield, L. M. SAFLEY,
Superintendent

Middle Tennessee Experiment Station, Spring Hill, E. J. CHAPMAN,
Superintendent

Plateau Experiment Station, Crossville, J. A. ODOM, Superintendent

Tobacco Experiment Station, Greeneville, J. H. FELTS, Superintendent

West Tennessee Experiment Station, Jackson, B. P. HAZLEWOOD,
Superintendent

Field Stations

Ames Plantation, Grand Junction

Cumberland Plateau Forestry Field Station, Wartburg

Friendship Forestry Field Station, Chattanooga

Highland Rim Forestry Field Station, Tullahoma