PERFORMANCE OF GREENBUG RESISTANT HYBRIDS IN THE ARKANSAS VALLEY, 1976

COLORADO STATE UNIVERSITY EXPERIMENT STATION
FORT COLLINS
GENERAL SERIES 962

EXPERIMENT STATION

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by

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INTRODUCTION

This past year was the U.S. Bicentennial Year to most folks and the Centennial Year in Colorado. As far as sorghum growers are concerned, it will be recalled as the year that greenbug resistance arrived.

Greenbugs developed a taste for grain and forage sorghum in 1968. Biotype C has since become a serious threat to sorghum crops in the Great Plains.

Kansas State University scientists at Hayes released greenbug resistant lines several years ago. Advances and releases were also made by Oklahoma State University, Texas A & M, and the USDA.

Many private breeders have used the various lines in their crosses, leading to the development of a substantial number of 'greenbug-fighting' hybrids available to farmers in 1976.

This bulletin is a progress report of a sorghum trial conducted by the Department of Agronomy, Colorado State University, at Rocky Ford. The test was financed in part by entry fees paid by commercial seed firms. The firms selected entries for testing and furnished seed for the trial.

The names and addresses of the firms involved, are given in Table 1. A total of 44 entries were planted. Two check hybrids were included in the test. Pioneer brand 833 and RS671 have for a number of years produced excellent yields in the Arkansas Valley, and were the susceptible check hybrids chosen. Funk G-522 was entered in the trial and is classed as a susceptible hybrid by Funk Seeds International.

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Table 1.--Entrants in the Greenbug-Resistant Grain Sorghum Performance Test at Rocky Ford, 1976

Brand	Entered by:
ACCO	ACCO Seed, Box 1630, Plainview, TX 79072
ASGROW	ASGROW SEED COMPANY, P.O. Box 2010, Des Moines, Iowa 50310
COOP	Farmland Industries, Inc., Box 7305, Kansas City, Missouri 64116
DEKALB	DEKALB AgResearch, Inc., Route 2, Lubbock, TX 79415
FUNK	Funk Seeds International, 719 26th St., Lubbock, Texas 79404
GOLDEN ACRES	Taylor-Evans Seed Co., Box 68, Tulia, Texas 79088
GROWERS	Growers Seed Association, Box 1656, Lubbock, Texas 79408
NC+	NC+ Hybrids, 3820 No. 56th St., Lincoln, Nebr. 68504
NORTHRUP KING	Northrup, King & Co., Box 998, Longmont, Colo. 80501
PIONEER	Garst & Thomas Hybrid Corn Co., Coon Rapids, Iowa 50058
PRAIRIE VALLEY HYBRIDS	Prairie Valley, Inc., Box 125, Phillips, Nebr. 68865
RUDY-PATRICK	North American Plant Breeders, Box 568, Hutchinson, Kansas 67501
TRIUMPH TWO	Texas Triumph Seed Co., Inc., Box 387, Ralls, Texas 79357
WARNER	George Warner Seed Co., Box 1448, Hereford, Texas 79045
WILSON HYBRIDS, INC.	Wilson Hybrids, Box 391, Harlan, Iowa 51537

TESTING PROCEDURES

Individual plots of each hybrid consisted of 4 rows, 70 feet in length. Each plot was split and the flip of a coin determined which of the 35' plots would receive insecticide and which would not be sprayed. Plots were replicated three times.

Plots were seeded on May 13. Soil moisture and temperature were favorable for good germination and rapid seedling emergence. The plot area had been fertilized with 100 pounds of nitrogen and 50 pounds of P_2O_5 in accordance with the recommendations of a soil test. A combination of 2.89 pounds of ramrod and 1.25 pounds of atrazine was applied to the area for weed control.

The plot area was irrigated four times: May 19, June 17, July 21, and August 23. Furadan 4F was applied at 0.5 pound AI per acre on July 15, July 30, and August 13 on the sprayed plots. The parasite Lysiphlebus testaceipes (Cresson) had developed high populations in the plots by August 20 and greenbug populations were nearly eliminated shortly thereafter.

GENERAL DISCUSSION OF RESISTANCE

Painter[2/] describes insect resistance in plants as the relative amount of heritable qualities possessed by a plant which influences the ultimate degree of damage done by the insect. In practical agriculture this represents the ability of a certain variety to produce a larger crop of good quality than do ordinary varieties at the same level of insect population. The two extremes within which resistance ranges includes immunity, under which a specific insect will never consume or injure a particular variety under any known condition, to susceptible, wherein a variety shows average or more than average damage

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2/ Painter, R.H. 1951. Insect resistance in crop plants. The University Press of Kansas, Lawrence. 520 pp.

by an insect. Resistance in crops can range from high, which results in small damage by a specific insect under a given set of conditions, to low, in which a variety shows slightly less damage or infestation by an insect than the average for the crop under consideration. The resistance of a variety is generally relative and definable only in terms of comparison to other and usually more susceptible varieties.

Three mechanisms have been identified as the bases for resistance as seen in the field. They include:

1. Non-preference - Includes the group of plant characters and insect responses which result in an insect not using a particular plant or variety for egg laying, food, shelter, or a combination of the three.
2. Antiboisis - The prevention, injury, or destruction of insect life. These host plant effects on the insect include reduced egg laying, decreased size, abnormal length of life, and increased mortality.
3. Tolerance - The plant shows an ability to grow and reproduce itself or to repair injury to a marked degree in spite of supporting an insect population approximately equal to that damaging a susceptible host.

One or more of these mechanisms can exist in a resistant plant at the same time. In the field it is difficult to determine whether reduced populations are due to non-preference or antibiosis. The existing environmental conditions can also act to influence the effect of resistance.

RESULTS

Selected agronomic data for the cultivars entered in the trial are presented in Table 2. No differences in flowering, maturity, or leaf number are to be attributed to the greenbug treatment. Bird populations have increased sharply in the Rocky Ford area in recent years. Starlings, blackbirds, and sparrows invaded the plot areas in rather large numbers. An A-V Alarm, Model

Table 2. -- Agronomic Data for Cultivars Tested in Greenbug-Resistant Trial at Rocky Ford, 1976.

Brand	Hybrid	Sprayed				Unsprayed			
		Days to		Leaf	Bird	Days to		Leaf	Bird
		Flower	Mature	Count	Damage	Flower	Mature	Count	Damage
		(No.)	(No.)	(No.)	(%)	(No.)	(No.)	(No.)	(%)
ACCO	X-0912	90	150	15	5	90	150	15	5
ASGROW	Bug Off	91	148	16	0	91	148	15	0
ASGROW	Bug Off L	92	150	15	5	92	150	15	0
ASGROW	H757	93	154	16	0	92	152	15	5
DEKALB	E-59+	97	148	16	0	97	148	16	0
DEKALB	F-61+	95	151	16	0	95	151	16	0
DEKALB	E-57+	89	142	15	20	90	143	15	10
DEKALB	F-67	103	155	16	0	106	155	16	0
DEKALB	C-42a+	85	150	13	35	85	149	14	40
COOP	SG-40GBR	95	150	15	0	95	149	15	0
FUNK	G-520	89	142	15	15	89	144	16	15
FUNK	G-520GBR	88	150	14	25	88	150	14	40
FUNK	G-522	97	153	16	0	97	153	16	0
FUNK	G-622GBR	94	148	16	5	93	148	16	5
PIONEER	8451	90	148	15	10	90	148	15	10
GROWERS	GSA-1310	93	148	16	0	93	147	16	0
GROWERS	GSA-1210A	84	147	14	30	84	146	15	30
GROWERS	ML 136A	93	151	16	5	94	152	16	10
NC+	170	98	153	16	0	98	153	16	0
NC+	171	95	150	18	5	97	149	17	5
NC+	173	95	152	16	10	95	152	15	5
NC+	168	95	152	15	0	95	152	15	0
NC+	161	80	---	13	100	81	---	13	100
NC+	162	84	146	13	50	83	146	13	70
NORTHRUP KING	NK233A	79	---	12	100	79	---	12	100
NORTHRUP KING	NK266A	88	146	14	15	88	146	15	20
NORTHRUP KING	NK278	99	154	17	0	102	154	18	0
PRAIRIE VALLEY	PV729	91	149	17	0	91	149	16	10
PRAIRIE VALLEY	PV609	84	142	14	40	85	142	13	40
PRAIRIE VALLEY	PV687	92	150	15	0	92	148	16	0
PRAIRIE VALLEY	PV738	92	150	16	10	95	150	16	10
GOLDEN ACRES	T-E Y-101-R	96	151	15	10	95	150	17	10
GOLDEN ACRES	T-E Total-R	93	149	16	10	93	149	15	5
GOLDEN ACRES	T-E 7536	81	---	13	100	81	---	13	100
GOLDEN ACRES	T-E 7545	90	150	15	5	90	150	15	10
GOLDEN ACRES	T-E 7550	84	144	14	40	84	144	13	40
GOLDEN ACRES	T-E 7551	84	135	14	0	84	134	14	0
TRIUMPH TWO	Two62y-G	93	150	16	0	93	150	16	0
TRIUMPH TWO	X48767	95	150	16	10	95	148	16	5
WARNER	W-839T	92	149	15	5	92	148	16	0
WARNER	Double Yellow 5T	90	147	16	10	90	148	16	10
WARNER	W-561T	84	144	12	40	83	142	12	30
PIONEER	833 (check)	92	149	17	10	92	150	17	10
	RS671 (check)	92	145	15	10	95	150	15	10

ST-1 was installed in an effort to control the avian invasion. Bird damage between hybrids varied, but there was little or no difference between sub-plots. Three hybrids, NC+ 161, NK 233A, and T-E 7536 were severely damaged by birds. The lack of yield data for these three hybrids will be noted. No grain remained in the heads at harvest time.

Greenbug damage to leaves and counts for cultivars in the trial are presented in Table 3. If growers are interested in the maximum yield they can obtain from a resistant variety in the presence of high greenbug populations, they should note the ranking of the yields from the unsprayed plots. Fourteen hybrids produced yields in excess of 5500 pounds, and thus should certainly be strongly considered as greenbug resistant hybrids.

Greenbug counts taken August 11 in the untreated plots are an indication of the relative level of non-preference and/or antibiosis in the plants. On the same date, counts were taken in treated plots, which was just prior to the third sprays, to determine the approximate control obtained at the time of maximum greenbug infestation in the plots.

Percent leaf loss or damage was determined from the average number of leaves destroyed by October 6, 1977 divided by the total number of leaves existing on the plant after lay-by time. A small number of leaves were lost on plants in the treated plots due mostly to natural senescence of the lower leaves. The actual leaf loss due to greenbug damage should approximate the difference in leaf loss between treated and untreated plots for a particular variety. Leaf damage by the greenbugs occurred from the bottom leaves up.

Leaf loss indicates a combination of damage by and level of tolerance in the plant to greenbug attack. As an example, lower populations of greenbugs in untreated plots combined with high percentage leaf loss indicates low tolerance while higher greenbug populations combined with low percentage leaf

Table 3. -- Greenbug Damage and Counts for Cultivars Tested in the Greenbug-Resistant Trial at Rocky Ford, 1976.

Brand	Hybrid	Sprayed				Unsprayed		
		Leaf Loss	Greenbug Count	Yield	Rank	Leaf Loss	Greenbug Count	Yield
		(%)	(No.)	(Lbs)	(No)	(%)	(No.)	(Lbs)
DEKALB	F-61+	17	0	7245	8	47	950	6590
ASGROW	Bug Off	18	8	7985	2	57	800	6070
ASGROW	H757	20	0	7155	13	51	1270	6040
PRAIRIE VALLEY	PV729	18	20	7055	18	47	965	5910
TRIUMPH TWO	X48767	15	20	7015	19	45	900	5880
NC+	168	20	0	7260	7	42	1050	5865
WARNER	W-839T	20	17	6900	21	56	1125	5795
COOP	SG-40GBR	22	60	6955	20	48	1435	5620
GOLDEN ACRES	T-E7545	20	0	7130	14	48	575	5590
DEKALB	E-59+	17	35	7535	3	48	990	5575
GOLDEN ACRES	T-E7551	19	16	6660	28	40	1015	5550
NC+	17D	19	17	6740	23	53	875	5545
PRAIRIE VALLEY	PV687	18	0	7130	15	62	1000	5545
ASGROW	Bug Off L	20	8	7155	12	50	915	5500
GROWERS	GSA-1310	20	15	7480	4	50	1290	5460
TRIUMPH TWO	62y-G	15	0	7175	10	54	1175	5300
GOLDEN ACRES	T-E Y-101-R	25	25	7090	16	50	525	5260
WARNER	Double Yellow 5T	20	8	6535	30	47	825	5255
FUNK	G-622GBR	20	25	8115	1	56	1100	5140
NC+	173	15	15	7055	17	51	1490	5025
GOLDEN ACRES	T-E7550	20	25	5985	37	65	800	4935
PRAIRIE VALLEY	PV738	17	17	7230	9	55	800	4890
GROWER	ML136A	17	33	7360	5	52	770	4880
PIONEER	8451	20	8	6795	22	53	1100	4850
ACCO	X-0912	20	8	7175	11	65	780	4255
DEKALB	C-42a+	23	35	6105	30	52	720	4125
GROWERS	GSA 1210A	19	8	5970	38	51	770	4095
NC+	171	15	33	6665	27	50	890	4090
FUNK	G-520GBR	21	35	6100	36	58	1340	4080
GOLDEN ACRES	T-E Total-R	15	0	6175	33	50	1400	3950
DEKALB	E-57+	20	8	6580	29	63	1150	3935
FUNK	G-520	27	42	6670	26	63	525	3645
WARNER	W-561T	24	0	5390	40	67	600	3570
DEKALB	F-67	19	16	5010	41	37	285	3560
PRAIRIE VALLEY	PV609	20	33	6375	31	58	1150	3540
NC+	162	21	17	6710	25	54	750	3270
	RS671 (check)	22	17	7505	6	70	1170	2390
PIONEER	833 (check)	26	25	6740	24	74	825	1670
NORTHRUP KING	NK278	20	58	6290	32	62	1170	1785
NORTHRUP KING	NK266A	30	75	5790	39	80	1240	1665
FUNK	G-522	19	33	6170	34	74	1040	1175
NC+	161	18	0	----		65	750	----
NORTHRUP KING	NK233A	25	8	----		87	1020	----
GOLDEN ACRES	T-E7536	25	15	----		50	560	----

loss indicates increased tolerance levels in the plant.

Those growers wanting maximum production should note the yields from the sprayed plots which are ranked from high to low in Table 4. In all cases except one, the cultivar produced a significantly higher yield when sprayed. A difference of 680 pounds of grain was required for significance between sprayed and unsprayed treatments.

The difference in yields for each variety between sprayed and unsprayed plots is an indication of the practical effect of resistance to the greenbug in each variety. These data are shown in Table 4. The greater yield difference the less inherent resistance in a particular variety.

Table 4. -- Comparison of Yields of Cultivars Tested in the Greenbug-Resistant Test at Rocky Ford, 1976.

Sprayed Rank	Brand	Hybrid	Sprayed	Unsprayed Yield	Unsprayed Rank	Difference Yield[1/]	Difference Rank
			(Lbs)	(Lbs)	(No)	(Lbs)	(No)
1	FUNK	622GBR	8115	5140	18	2975	34
2	ASGROW	Bug Off	7985	6070	2	1915	20
3	DEKALB	E-59+	7535	5575	9	1960	22
4	GROWERS	1310	7480	5460	14	2020	24-25
5	GROWERS	ML136A	7360	4880	22	2480	29
6		RS 671 (check)	7300	2365	36	4935	39
7	NC+	168	7260	5865	6	1395	11
8	DEKALB	F-61+	7245	6590	1	655	1
9	PRAIRIE VALLEY	PV738	7230	4895	21	2335	28
10	TRIUMPH TWO	62yG	7170	5300	15	1870	18
11	ACCO	0912	7170	4255	24	2915	33
12	ASGROW	Bug Off L	7160	5505	13	1655	15
13	ASGROW	H757	7155	6040	3	1115	40
14	GOLDEN ACRES	T-E 7545	7130	5590	8	1540	13
15	PRAIRIE VALLEY	PV687	7130	5545	12	1585	14
16	GOLDEN ACRES	T-E Y-101-R	7085	5255	16	1830	17
17	NC+	173	7060	5025	19	2035	26
18	PRAIRIE VALLEY	PV729	7055	5910	4	1145	7
19	TRIUMPH TWO	X48767	7015	5865	5	1150	6
20	COOP	SG40GBR	6955	5635	8	1320	10
21	WARNER	839T	6900	5795	7	1105	3
22	PIONEER	8451	6795	4850	23	1945	21
23	NC+	170	6740	5545	11	1195	8
24	PIONEER	833 (check)	6740	1670	8	5070	41
25	NC+	162	6710	3270	35	3440	36
26	FUNK	G520	6665	3645	31	3020	35
27	NC+	171	6665	4095	27	2570	30
28	GOLDEN ACRES	T-E 7551	6665	5545	10	1120	5
29	DEKALB	E57+	6580	3935	30	2645	31
30	WARNER	Double Yellow 5T	6535	5255	17	1280	9
31	PRAIRIE VALLEY	PV609	6375	3534	34	2830	32
32	NORTHRUP KING	NK278	6290	1785	37	4505	38
33	GOLDEN ACRES	T-E Total R	6175	3950	29	2220	27
34	FUNK	522	6170	1175	40	5125	40
35	DEKALB	C429a+	6105	4125	25	1975	23
36	FUNK	520GBR	6100	4080	28	2020	24-25
37	GOLDEN ACRES	T-E 7550	5985	4935	20	1050	2
38	GROWERS	GSA 1210A	5970	4095	26	1875	19
39	NORTHRUP KING	NK266A	5790	1670	39	4120	37
40	WARNER	W561T	5390	3570	32	1815	16
41	DEKALB	F-67	5010	3560	33	1450	12
42	NC+	161	----	----		----	
43	NORTHRUP KING	NK233A	----	----		----	
44	GOLDEN ACRES	T-E 7536	----	----		----	
		AVERAGE	6776	4560		2225	

1/ L.S.D. between treated and untreated, 680 pounds