

KEEPING UP-TO-DATE ON OATS¹

By T. E. STOA² and C. M. SWALLERS²

The rust epidemics for the four years 1941 to 1944, in the eastern part of the state, emphasized the need for protection against rust and demonstrated the advantage of resistant varieties. The extent of the injury from rust during this period in the Fargo area, and the five years since then when rust was not a factor, can be seen in Table 1.

The degree and extent of the injury is particularly noted in Gopher, a satisfactory and high yielding variety when not rusted. Compared with Vieland during the non-rust years, Gopher averaged about four bushels or five per cent higher yield than Vieland. For the rust years, however, the yield of Vieland, a variety resistant to both stem and crown rust, averaged about 63 per cent higher than Gopher. In other words the Gopher yield was cut about 40 per cent due to the rust.

Marion, another variety capable of high yields and about the same maturity as Gopher and Vieland, is resistant to stem rust and only moderately resistant to crown rust. This lower resistance to crown rust is apparent in the lower average yield for the rust years, compared with Vieland. This is also noted in the comparison of Rainbow and Vieland for the two periods.

Table 1. SHOWING HOW SOME OATS VARIETIES COMPARED IN YIELD IN RUST AND NON-RUST YEARS.

Variety	Average yield, bushels per acre			
	Rust years		Non-rust years*	
	1941-1944	In % of Gopher	1945-1949	In % of Gopher
Gopher.....	38.8	100	82.2	100
Vieland.....	63.1	163	78.3	95
Marion.....	57.3	148	82.7	101
Rainbow.....	56.1	145	85.1	104
Vanguard.....	40.9	105	....	...
Victory.....	32.6	84	75.4	92

*Occasionally some rust present, but damage negligible.

Vanguard is similar to Rainbow in time of maturity and resistance to stem rust but is lacking in resistance to crown rust. This is reflected in the distinctly lower yield for Vanguard during the 1941-1944 period, compared with Rainbow. Victory, a later ripening variety, lacks in resistance to both rusts, and so its yield suffered not only from rust injury but also from high temperature during the ripening period.

¹The writers are indebted to the following men for supervision of the trials at the several branch stations: Edgeley, J. P. Tiernan; Langdon, Victor Sturlaugson; Minot, G. N. Geiszler; Dickinson, Leroy Moomaw and T. J. Conlon; Williston, Arlon Hazen and Elvin Anderson.

²Agronomist.

³Assistant Agronomist.

Stem and Crown Rust

As indicated there are two rusts to contend with, stem rust (*Puccinia graminis avenae*) and crown (leaf) rust (*Puccinia coronata*). Within each of these rust species there is further specialization, separating the species into a number of races, some of which are more common than others. Then too, a variety may be resistant to a number of these races, but not to others, perhaps races not now prevalent but which could become common a few years hence. Statements with respect to comparative resistance as used here are in reference to the reaction of the variety to those prevailing and known races against which a variety has been tested.

Early ripening varieties, though susceptible to rust, may "escape" serious injury in some years. A later ripening variety, no more susceptible, will be exposed to rust over a longer period and its yield damaged more seriously.

The blight and root-rot organism, Victoria blight disease (*Helminthosporium victoriae*), first noted and described a few years ago, is a soil-borne as well as seed-borne organism. It has been observed in Richland county. Some varieties, particularly those tracing to crosses with Victoria, are more susceptible to this disease than others.

Thus we may see that the performance of any crop variety over a period of years, or over a given area, is dependent on a number of factors. The extent to which rusts, or other air-borne diseases, are a factor must depend first upon the presence of the disease organism. Once present the development and spread of the disease depends upon favorable temperatures, rainfall, high humidity and susceptible host plants on which the organism may develop and spread. No one can foretell what the disease conditions or seasonal environment will be in any given season or area. However, past experiences have shown that conditions are more favorable for disease development in the eastern part of the state and therefore resistant varieties should have preference in that area.

Early versus Later Ripening Varieties

The oat crop is sensitive to unfavorable high temperatures, which frequently occur during the ripening season. Since these periods of high temperatures are more likely to occur after about mid-July and into early August in this area, the varieties that head and ripen early tend to "escape" these unfavorable conditions. They will have more closely approached their normal yield than later varieties which are less developed when the high temperatures occurred, and hence receive relatively less injury. For these reasons early varieties usually yield more dependably in some sections and in some years. Since ripening temperatures usually are higher in the southeastern sections of our state, early varieties will usually be injured less than later ones. On the other hand, in more northern sections of the state, where temperatures normally are lower, later varieties can, and frequently do, yield better than those which mature in a shorter season. Early varieties also frequently yield satisfactorily, in relation to other varieties, in the more western part of the state, but are not in such general favor because of their short straw.

Most varieties have some merit. They also have limitations, some of which are more serious than others. A careful grower will choose the variety which combines best those characteristics which experience has shown to be most desirable for his particular region and specific conditions. In some sections this may be rust resistance. In other instances, time of maturity, capacity for yield or strength of straw may have more importance. The advantages and limitations of a number of varieties claiming attention are described herewith.

How Varieties Differ

Gopher was for many years one of the leading varieties in North Dakota. Despite its earliness it is an excellent yielder, has fairly strong straw, although somewhat short in dry years, fairly plump attractive white grain, that has appealed to many growers. While resistant to the blight, *Helminthosporium victoriae*, Gopher lacks in resistance to both stem and crown rust, and seemingly is no longer a good risk in the eastern sections of the state where conditions may frequently favor rust development.

Marion is from a Markton-Rainbow cross, released from the Iowa Experiment Station. Marion has the resistance to stem rust of its Rainbow parent, resistance to blight, moderate resistance to crown rust and the smut resistance of Markton. It is an early white oat, taller, but weaker straw than Gopher. A good yielding variety, fair test weight, suitable for areas where an early oat with fairly long straw is desired and the rust hazards not too great.

Rainbow is a selection by the North Dakota Agricultural Experiment Station from common Green Russian, a selection based on resistance to stem rust. Rainbow is resistant to the common races of stem rust, has moderate resistance to crown rust but lacks in resistance to smut. This is an early mid-season variety with greenish-yellow kernel, fairly tall, but slightly weak straw, and has been an excellent yielding variety over a wide range of conditions.

Vicland is a selection from the cross, Victoria x Richland, released from the Wisconsin Experiment Station. This yellow oat compares with Gopher in length of straw and time of maturity. Vicland is resistant to the common races of stem rust, most races of crown rust, also smut. It yields satisfactorily, and has good test weight. However, it is susceptible to the blight, *H. victoriae*, which has proven very destructive in the central states and has been observed in some North Dakota fields, particularly in the southeastern part of the state. Varieties quite comparable to Vicland and grown to some extent in North Dakota include Tama and Boone.

Clinton is from a cross between Iowa D69, a stem rust-resistant hybrid and Bond, a crown rust and smut-resistant stiff-strawed oat from Australia. The cross and selection was made at the Iowa Experiment Station. Clinton is an early to mid-early ripening variety, slightly taller than Gopher, but lacking some in uniformity of plant type. Clinton has strong straw, yellowish plump grain, high test weight, is resistant to all common races of stem rust, the common races of crown rust, except

Race 45; resistant to blight and many of the common races of the oat smuts. Clinton has not shown as high a capacity for yield as some of the less resistant varieties, thus is suggested mainly for the south-eastern and eastern counties, where earliness, maximum rust protection, resistance to root rot and strength of straw are desired.

Table 2. COMPARATIVE ANNUAL AND AVERAGE YIELDS OF STANDARD AND PROMISING NEW OAT VARIETIES.

Agricultural Experiment Station, Fargo, N. Dak. 1941 to 1949												
Yield in bushels per acre												
Variety	1941	1942	1943	1944	1945	1946	1947	1948	1949	Average		
										1946 to 1949	1943 to 1949	1939 to 1949
Early:												
Gopher	38.3	62.7	21.7	32.3	54.6	101.7	86.4	91.5	76.9	89.1	66.4	60.2
Marion	58.1	86.6	40.9	43.5	54.5	104.9	81.4	100.4	72.4	89.8	71.1	67.1
Vieland	60.2	87.9	51.0	53.1	53.5	99.6	72.1	97.0	69.4	84.5	70.8	66.6 ¹
Ajax			51.4	48.4	58.2	97.2	84.5	105.9	79.4	91.8	75.0	
Clinton				42.6	54.0	98.0	73.9	88.2	68.2	82.1		
Bonda					49.5	86.7	74.7	83.9	61.2	76.6		
Benton						97.6	76.5	88.6	64.5	81.8		
Mindo						100.9	71.3	82.9	63.8	79.7		
Early midseason:												
Rainbow	58.7	86.4	41.5	37.7 ²	61.4	103.5	79.3	106.0	75.1	91.0	72.1	67.2
Vanguard	46.4	68.1	28.7	20.6 ²	57.5	99.6	75.1	.....	.....	
Beaver							65.5	90.0	78.1			
Late midseason:												
Victory	30.8	69.3	12.1	18.0 ²	51.5	88.9	72.7	90.2	73.6	81.4	58.1	53.0

¹ Not grown 1939, 1940—Boone subst.

² Corrected for estimated yield loss due to shattering after hard rains before harvesting was possible.

A number of selections from Clinton have been made, some of which are in commercial production. Such advantage as any of these may have over Clinton is mainly in greater uniformity of plant type.

Benton like Clinton is from the cross D69 x Bond. This selection was made by and released from the Indiana Experiment Station. Benton compares closely with Clinton in disease resistance, but grows taller and is more uniform in plant type; yields about the same or slightly less. Its advantage over Clinton is mainly in longer straw, for use on lighter soils.

Cherokee is a selection from the same cross as Clinton, shorter straw, slightly earlier in ripening, with about the same disease resistance as Clinton.

Bonda is from a cross Bond x Anthony, by the Minnesota Experiment Station, released in 1946. This is an early to mid-early variety with about the same disease resistance as Clinton. Bonda has thin hull, ivory color, plump heavy grain of high test weight, grows tall, stands up well, but has not been a high yielding variety in our trials. Its tendency to consistently lower yields than many of the other varieties is its principal limitation.

Table 3. COMPARING AVERAGE YIELDS OF LEADING OAT VARIETIES AT EDGELEY AND DICKINSON.

Variety	Yield in bushels per acre							
	Results at Edgeley				Results at Dickinson			
	1946-49	1944-49	1943-49	1941-49	1946-49	1944-49	1943-49	1940-49
Early:								
Gopher	51.8	53.0	55.7	55.0	56.0	58.4	57.0	54.9
Marion	50.0	50.3	53.2	56.0	57.1	57.2	55.2	53.5
Vicland	45.2	49.5	53.4	57.7	1	1	1	
Ajax	54.7	56.5	60.4	....	58.6	57.9	56.2	....
Clinton	42.0	49.6	....	....	53.3	53.1	....	....
Bonda	42.5	....	....	....	46.6 ²	....	....	....
Benton	39.8	....	....	....	48.3	....	....	....
Mindo	43.9	....	....	....	....	....	....	....
Early midseason:								
Rainbow	53.4	54.0	56.5	58.4	58.5	57.7	55.9	55.4
Vanguard	....	....	....	....	52.5	56.0	55.0	54.5
Late midseason:								
Victory	No longer grown, not suited				56.9	59.7	57.7	56.5

¹Discontinued after 1947. For the 8 years grown Vicland averaged 50.9 bu.; Gopher 54.2 bu.

²Discontinued after 1948—yield for 1949 calculated on basis of earlier years.

Mindo is a very early ripening short-strawed variety, selected and released from the Minnesota Experiment Station from the cross [Bond x (Minota—White Russian) x Black Mesdag]. It is satisfactory in resistance to the common oat diseases, fair, but not outstanding in yield in our trials. Mindo is earlier in ripening than Vicland, which in some years or areas may be an advantage, but when too early usually does not promise the higher yield. Not expected to occupy any large acreage in our state.

Ajax is from the cross, Victory x Hajira, made at the Dominion Laboratory of Cereal Breeding, Winnipeg. This is an early to mid-early oat with mid-tall, fairly strong straw, frequently awned white kernels, and an excellent capacity for yield. Ajax is resistant to most common races of stem rust (not 8 and 10), but lacking in resistance to most races of crown rust and the smuts. An increasingly popular variety because of its high yields. Limited resistance to crown rust is its principal disadvantage and this suggests a word of caution to growers in the more common rust areas of the state.

Vanguard (No. 7) is from a cross Hajira x Banner, made at the Dominion Laboratory of Cereal Breeding, Winnipeg. Released in 1936, Vanguard is an early midseason variety, only slightly later than Rainbow, grows to good height, has moderately strong straw and fairly plump white kernels. Vanguard is resistant to most common races of stem rust, lacks in resistance to crown rust, and is moderately susceptible to both oat smuts. Fair, but not outstanding in yield, in our tests.

Beaver compares with Vanguard in time of ripening, was developed at the Central Experimental Farm, Ottawa and is from the cross Vanguard x Erban. Beaver grows to good height, has fairly strong straw, plump white kernel, good test weight, and is resistant to the more com-

mon races of stem rust, is moderately resistant to crown rust but susceptible to smut. Has not been outstanding in our trials to date and is not expected to take over any important acreage in the state.

Table 4. COMPARING AVERAGE YIELDS OF LEADING OAT VARIETIES AT MINOT AND LANGDON.

Variety	Yield in bushels per acre						
	Results at Minot			Results at Langdon			
	1947-48	1946-48	1945-48	1947-49	1946-49	1943-49	1943-47
Early:							
Gopher.....	80.3	72.7	75.2	.....	.....	.....	.....
Marion.....	77.7	73.1	77.0	.....	.....	.....	.....
Vicland.....	.....	.....	.....	.....	.....	.....	79.7
Ajax.....	85.9	76.5	81.1	94.4	89.2	90.8	92.1
Clinton.....	68.9	62.0	.....	79.2	73.7	.....	.....
Bonda.....	64.9	59.3	.....	79.0	71.6	.....	.....
Benton.....	63.0	.....	.....	.....	.....	.....	.....
Mindo.....	64.4	58.1	.....	.....	.....	.....	.....
Early midseason:							
Rainbow.....	80.6	71.8	74.4	99.9	94.6	91.7	90.5
Vanguard.....	79.2	73.3	77.8	92.0	87.6	84.7	84.0
Beaver.....	71.3	.....	.....	85.5	.....	.....	.....
Late Midseason:							
Exeter.....	.....	.....	.....	100.3	94.7	91.5	88.5

Exeter is from a cross Victory x Rusota, made at the Dominion Laboratory of Cereal Breeding, Winnipeg, and first released in 1943. Exeter is a relatively late maturing variety, somewhat comparable to Victory, which limits its use to the more northern areas of our state where late varieties are less injured by high ripening temperatures. This variety has fairly tall medium strong straw, white kernel, is resistant to the common races of stem rust, but rather susceptible to crown rust and smut.

Newer Varieties

Oat improvement as we have it today, has progressed through several stages, each contributing something of value. The development and release of Richland (Iowa 105) by the Iowa Experiment Station; Rainbow by the North Dakota Experiment Station and Anthony by the Minnesota Experiment Station, were some of the first varieties with resistance to stem rust to come into extensive production in this area.¹ They are the sources for resistance to stem rust in a number of the varieties now grown. Hajira, an oat from Egypt, is another source.

The next important contribution came when one of these stem rust-resistant varieties, Richland was crossed with Victoria, an oat introduced from South America and found to be resistant to crown rust and to smut. Out of this combination came such varieties as Vicland, Tama, Boone, Vikota, Cedar and Control, all combining resistance to most of the common races of stem rust, crown rust and smut. Out of another cross, Markton x Rainbow came Marion, resistant to stem rust, smut, root

¹White Russian, a late ripening side oat grown quite extensively at one time was resistant to stem rust.

rot and moderate resistance to crown rust. These varieties became available at a very opportune time, during and following years of serious rust injury to the oat crop. The result was a prompt recognition of their advantages and their universal acceptance. While selections from the Victoria-Richland cross proved later to lack in resistance to blight (*Helminthosporium victoriae*) they were of much value for several years after 1940.

Table 5. COMPARING AVERAGE YIELDS OF LEADING OAT VARIETIES AT WILLISTON DRYLAND AND WILLISTON IRRIGATION STATIONS.

Variety	Yield in bushels per acre							
	Williston (dry land)				Williston (irrigation)			
	1946-49	1944-49	1943-49	1942-49	1946-49	1944-49	1943-49	1942-49
Early:								
Gopher	57.3	65.9	69.6	70.4	105.9	93.9	91.1	88.2
Marion	55.2	63.2	67.5	68.7	95.3	83.6	80.1	76.2
Vicland	58.3	66.2	71.1	....	103.9	94.3	94.0	....
Ajax	56.4	65.3	....	....	102.1	....	....	....
Clinton	51.4	....	....	....	89.1	....	....	....
Bonda	48.5	....	....	....	84.4	....	....	....
Benton ¹	49.7	....	....	....	....	....	....	....
Early midseason:								
Rainbow	51.6	60.2	64.9	66.1	101.3	91.9	90.7	88.0
Vanguard	47.0	56.6	61.7	64.3	102.4	92.0	90.9	88.4

Bond Hybrids

Another important forward step was achieved with the development and release of a series of varieties often referred to as the Bond hybrids. These were represented in this area by Clinton, Benton, Cherokee Bonda and Mindo. These combine resistance to one more race of stem rust than available in the Victoria-Richland selections, resistance to *Helminthosporium victoriae* (blight) and resistance to most races of crown rust, except race 45, and strength of straw.

From now on the improvements to be gained are likely to be smaller and less striking. Resistance to other races of rust and smut may be added; resistance to other less common diseases and higher yields in the more resistant varieties are some improvements which can be hoped for. New varieties now coming into early farm production offer some promise over varieties now in use. However, they are not the final answer to our oat problems. Their advantages and limitations, in so far as now known, are discussed briefly here.

Andrew is a selection from the cross Bond x Rainbow, made at the Minnesota Experiment Station and released in 1949. Andrew is an early yellow oat with short, moderately strong straw. It is resistant to the most common races of stem rust (except race 8), most races of crown rust and smut. Grown in our trials during the last two years, Andrew has usually outyielded most of the other Bond hybrids. However, since rust was not a problem during these two years, some varieties lacking in resistance have yielded as well or better.

Zephyr is another introduction from Minnesota, the result of a selection from the cross Bond x Anthony. Zephyr ripens later than Bonda, comparing more with early midseason varieties, straw good height, but not as strong as Bonda or Clinton, has large plump kernels, grayish in color, good test weight. Disease resistance considered comparable to Bonda, Clinton and others. It is expected that Zephyr may yield more satisfactorily than Bonda and some of the other Bond hybrids.

Shelby is a selection from a Bond-Anthony cross made at the Iowa Experiment Station, and released in 1950. Shelby is an early mid-season maturing variety with near white or ivory colored kernels, grows to good height, mid-strong straw. Shelby compares in resistance to stem rust and smut with Clinton, but is believed to have more tolerance to Race 45 of crown rust. Yield comparisons with Shelby have been encouraging but are still too few to draw specific conclusions. The fact that it is later in ripening, suggests that it may be most satisfactory in the more northern sections of the usual rust area.

Summary

Stem and crown rust can cause serious injury to the oat crop and did so during the years 1941 to 1944.

Rusts are most likely to develop in areas of higher rainfall and humidity, hence the hazards of rust in North Dakota are greatest in the eastern part of the state.

Early ripening varieties tend to "escape" injury from rust in contrast to later ripening varieties. They also have a better chance to "escape" some of the injury associated with high ripening temperatures.

Rust resistant, early ripening varieties like Clinton and Benton should have preference in the southeastern and eastern sections of the state. Where the rust hazards are not as great some less resistant, high yielding varieties like Marion, Rainbow or Ajax will frequently yield better.

In the northern sections of the state later varieties usually yield better than those that ripen early.

Yield differences in the western sections of the state have usually been less than elsewhere, with mid-early varieties with longer straw having preference.

Early seeding to permit the crop to reach heading and ripening stages before summer temperatures become too high will usually be desirable.

While many of the newer varieties have considerable resistance to smut, seed treatment is still advisable.

Earlier Publications on Oats

The following articles and bulletins summarize all previous variety testing of oats in North Dakota. Oats testing began in 1892 (See Bulletin 164).

Which variety of oats to sow, by T. E. Stoa. N. Dak. Agr. Exp. Sta. Bimonthly Bulletin, Vol. 9, No. 3 (1947) pp. 59-66. Covers 1941-46.

Oats varieties and rust, by T. E. Stoa. N. Dak. Agr. Exp. Sta. Bimonthly Bulletin Vol. 7, No. 3, (1945) pp. 8-10. Covers 1930-44.

New Varieties of Oats for North Dakota—by T. E. Stoa and C. M. Swallers. N. Dak. Agr. Exp. Sta. Bimonthly Bulletin Vol. V No. 3, pp. 17-22, January 1943. Covers 1939-'42 at Fargo, 1940-'42 at Edgeley, 1940-'42 at Langdon, 1940-'42 at Dickinson and 1941-'42 at Williston.

Varieties of Oats for North Dakota—by T. E. Stoa and C. M. Swallers. N. Dak. Agr. Exp. Sta. Bimonthly Bulletin Vol. IV No. 3, pp. 24-30, January 1942. Covers 1927-'41 at Fargo, 1928-'39 at Edgeley, 1928-'34 at Langdon, 1928-'41 at Dickinson, 1930-'40 at Mandan, and 1928-'41 at Williston.

Cereal Crops at the Dickinson Substation—by Ralph W. Smith. N. Dak. Agr. Exp. Sta. Bimonthly Bulletin Vol. III No. 1, pp. 15-21, September 1940 (See Table I, p. 16). Covers 1930-1939.

Cereal Crops in Western North Dakota—Dickinson Substation—by Ralph W. Smith. N. Dak. Agr. Exp. Sta. Bimonthly Bulletin Vol. II No. 3, January 1940, pp. 8-11. See p. 10. Conclusions based on 1930-'39 records.

Oats in North Dakota—by T. E. Stoa, R. W. Smith and C. M. Swallers. N. Dak. Agr. Exp. Sta. Bulletin 287, June 1936. Covers 1922-1935 at Fargo, 1922-1932 at Edgeley, 1922-1934 at Langdon, 1922-1935 at Dickinson, 1922-1933 at Williston.

Variety Trials With Oats—by T. E. Stoa. N. Dak. Agr. Exp. Sta. Bulletin 164, July 1922. Covers 1892-1921 at Fargo, 1907-1921 at Dickinson, 1903-1921 at Edgeley, 1909-1921 at Langdon, 1908-1921 at Williston, 1916-1921 at Mandan, and 1916-1917 at Hettinger.

LIVING HOUSEHOLD AND INDUSTRIAL PESTS WANTED

A new insect control project on Industrial Pests of the Household and Industrial Buildings is underway at the NDAC Experiment Station. In order to evaluate the lasting effects of the newer insecticides and moth-proofing compounds, living cultures are highly desirable.

In the course of spring housecleaning North Dakota housewives will occasionally find damaged and living specimens of household pests. Households, granaries and industrial concerns troubled with insect infestations are requested to send specimens and their damage to the Department of Agricultural Entomology, North Dakota Agricultural College, Fargo.

Specimens and damaged material can be securely placed in a tightly-sealed container such as a spice box, coffee can or small jar. Contrary to popular belief, the insects do not require much air and no ventilating punctures are required for the few days they will be sealed in the containers.

—Richard L. Post, Associate Entomologist.

ANTIBIOTICS A REMEDY FOR PLANT DISEASES¹

The use of antibiotic substances in the treatment of plant disease was discussed at a recent meeting of the associate committee on plant diseases at Winnipeg, Canada. Representatives of the Canadian National Research Council, the Dominion Department of Agriculture, and western universities participated in the discussion.

These substances, as penicillin and streptomycin, can be employed to promote plant growth. Experiments in American orchards and gardens have been encouraging, it was stated.

Chemical sprays now in use are expensive and frequently cause harm to the treated plant. Antibiotics, however, have a selective action and prevent disease without damage to the plant. It was predicted that preparations containing them would become relatively cheap following further investigational work.

¹Reported by RAE H. HARRIS, Cereal Technologist