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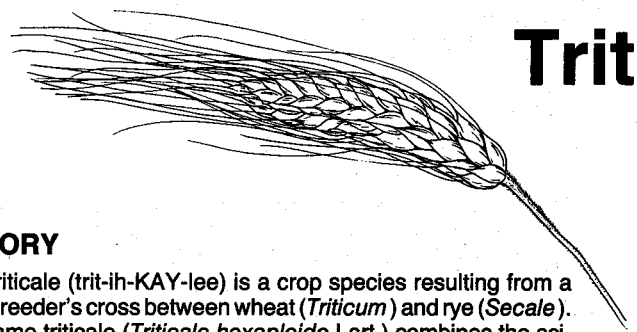

Triticale in Minnesota

E.A. Oelke and R.H. Busch

HISTORY

Triticale (trit-ih-KAY-lee) is a crop species resulting from a plant breeder's cross between wheat (*Triticum*) and rye (*Secale*). The name triticale (*Triticale hexaploide* Lart.) combines the scientific names of the two genera involved. It is produced by doubling the chromosomes of the sterile hybrid that results when crossing wheat and rye. This doubling produces what is called a polyploid.

Hybrids between wheat and rye date back to 1875 but until recently, there was little effort to develop high-yielding triticales as a field crop. Plant breeders originally wanted to include the combination of grain quality, productivity, and disease resistance of wheat with the vigor and hardiness of rye. The University of Manitoba began the first intensive program in North America about 30 years ago working mostly with durum wheat-rye crosses. Both winter and spring types were developed, with emphasis on spring types. Since Canada's program, other public and private programs have been initiated involving both the durum wheat-rye and the common wheat-rye crosses. The major triticale development program in North America is now at the International Maize and Wheat Improvement Center in Mexico, with some private companies continuing triticale programs; however, the University of Manitoba has discontinued its program.

Even though triticale is a cross between wheat and rye, it is self-pollinating (similar to wheat) and not cross pollinated (like rye). Most triticales which are agronomically desirable and breed true have resulted from several cycles of improvement, but are primarily from the durum-rye crosses with some common wheat parentage occasionally involved.

POTENTIAL USE

Plant breeders working with triticale hoped it would have higher yield than other cereal grains, especially under less than ideal growing conditions, and be used both as human and animal food.

Milling and Baking

Quality evaluations of triticale grain for milling and baking show it is inferior to bread-making wheat or to durum wheat for macaroni, but it is often considered superior to rye. Scientists are testing triticale for possible use in breakfast cereals and for distilling or brewing, but so far no exclusive commercial use has resulted. Table 1 decribes the chemical composition of a typical triticale variety.

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Table 1. Composition of triticale grain

Component	Percent of dry matter
Protein	18.71
Fiber	3.10
Fat	1.61
Calcium	.12
Phosphorus	.44
Total sugars (as invert)	5.74
Starch	67.78
Amino acids	
Threonine	.39
Valine	.93
Methionine	.40
Isoleucine	.76
Leucine	1.23
Phenylalanine	.85
Lysine	.57
Histidine	.45
Arginine	.80

[1]Source: Waibel et al., 1982, University of Minnesota.

Feed Grain

Feeding trials in North Dakota, Canada, and Minnesota indicate that triticale has potential as a feed grain. The protein contents of triticale lines have ranged from 13.5 to 19.5 percent on a dry weight basis which is higher than wheat. The amino acid composition of the protein is similar to wheat, but may be slightly higher in lysine. As triticale varieties are improved, they may compete with oats and feed barley as a home-grown feed crop, particularly if ergot, a fungus disease (*Claviceps purpurea*), can be eliminated or reduced to less than 0.1 percent in the grain. Higher levels of ergot have ruined the crop for feeding in some years however, ergot is more severe in older than in newer varieties.

Swine

Early North Dakota trials with swine found triticale unsatisfactory for feed and weight gain when fed as the only grain in a complete, balanced ration for growing-finishing swine. Fed a barley ration, for comparison, swine gained up to 27 percent faster than those on the triticale rations. Feed efficiencies on both the triticale and barley rations were similar: the problem was less intake due to unpalatability. The study indicated when equal parts triticale and barley represented half the grain fed, weight gain and efficiency were much improved over a straight triticale ration. Researchers wrote, "Triticale rations appear to be somewhat unpalatable to swine and the reduced consumption explains most of the differences in gain." The ergot content of the triticale varied and it was not possible to tell if ergot in the grain or the grain itself caused reduced feed intake.

Cattle

Feeding trials with cattle in North Dakota showed that when triticale was the only grain used in fattening rations, both gains and feed efficiency were reduced compared to barley rations. Usually, triticale was fed in smaller amounts and this partly explains the lower weight gains. Recent feeding trials at the University of Minnesota, conducted by Wright and others with calves, indicated starter rations containing up to 27 percent triticale as dry matter equaled weight gains and starter intakes in calves fed rations containing soybean meal (table 2).

Table 2. Weight gains and feed intake of calves fed diets containing soybean meal and triticale[1]

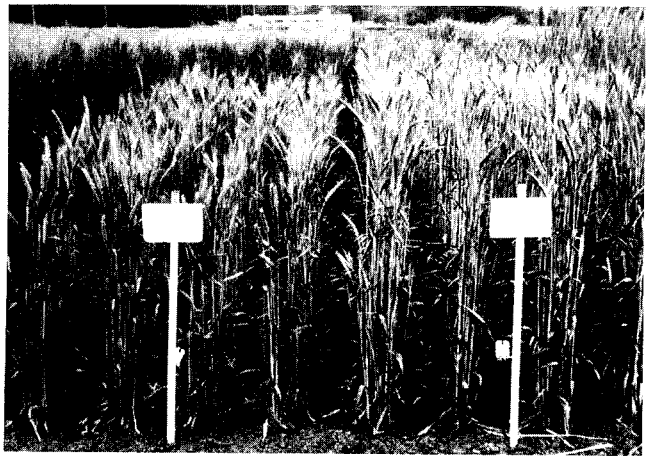
Item	Percent triticale in calf starter[2]	
	0[3]	27[4]
No. of calves	22	19
Average daily gain, lb.		
Day 4-28	.68	.71
29-56	1.29	1.08
4-56	.98	.89
Average starter intake, lb.		
Day 4-28	.50	.56
29-56	2.89	2.72
4-56	1.79	1.71

[1] Source: Wright et al., 1984, University of Minnesota.
[2] Basic starter composition: Oat 28 (%DM), Molasses dry 5, Decal 1, Limestone 1, Trace mineralized salt 1, Fat 2, Vit A 200 (X100 I.U.). Both diets were approximately 16% crude protein.
[3] Added to basic starter: Corn 48 and soybean meal 14.
[4] Added to basic starter: Corn 25, triticale 27, and soybean meal 10.

Poultry

Feeding trials of triticale (relatively free of ergot) with turkeys and laying hens at North Dakota State University showed that triticale was approximately equal to durum wheat for gain in body weight, feed use efficiency, and energy content.

A University of Minnesota study with turkeys by Wright and others in 1982 showed when triticale substituted for corn in the diet, growth improved significantly at 3 weeks of age. Feed efficiency with the entire triticale substitution was unchanged when compared to corn diet. When 25 percent triticale was included in a corn-soybean meal diet, both growth and feed efficiency were equal to a corn-soybean meal diet.



Triticale varieties being tested at the University of Manitoba, Winnipeg, Canada.

Forage

The forage yield and quality of triticale has been investigated at the University of Minnesota (1978-79) by Cherny and Marten who found barley, oat, and triticale had similar dry matter yields. However, oat yielded significantly less dry matter than triticale in 1979 at the University of Minnesota, St. Paul. Wheat often had the lowest dry matter yields. The mean in-vitro digestible dry matter (IVDDM) yields were 1.61, 1.43, 1.36, and 1.25 tons/acre for barley, triticale, oat, and wheat, respectively. These means were over six maturity stages from flag leaf to dough stage. Triticale, cut slightly before boot stage, makes the best silage similar to other small grains, but dry matter yields are higher at later maturity stages. Table 3 gives the crude protein and IVDDM comparison at the milk maturity stage for the four species. Recently, farmers have grown peas with triticale for silage.

Table 3. Crude protein concentration and yield and percent digestible dry matter and yield of four small grain species harvested at the milk stage of maturity[1]

Species	Crude protein		IVDDM	
	%	T/A	%	T/A
Spring wheat	15.7	0.43	63.3	1.72
Triticale	15.2	0.45	66.4	1.95
Oat	14.6	0.44	61.5	1.86
Barley	15.7	0.50	68.5	2.20

[1] Source: Cherney and Marten, 1982, University of Minnesota and USDA; means of two varieties, years and locations.

A study conducted in 1987 at the University of Minnesota's Agricultural Experiment Station-Rosemount by Paulson and others compared the use of alfalfa, triticale, or oat as the only forage sources in diets for cows for the first 116 days of lactation. Alfalfa (a composite of three cuttings and harvested at mid-bud stage), triticale (harvested at late boot with approximately 25 percent of the heads emerged) and oat (harvested at early heading) were ensiled in plastic silo bags. Forty-two cows were randomly assigned by parity to one of these diets. Diets were composed of a 50:50 ratio of forage: concentrate (dry matter basis) and balanced for calcium, phosphorus, and crude protein by changing the composition of the grain portion. Diets were fed as a total mixed ration using a Calan door feeding system in a loose housing facility.

Table 4. Forage and diet composition (dry matter basis)[1]

Item	Alfalfa	Triticale	Oat
		%	
Forage			
Dry matter	43.5	37.8	28.0
Crude protein	22.6	17.5	14.0
Neutral detergent fiber	43.8	54.8	52.4
Acid detergent fiber	32.9	32.1	31.1
Calcium	1.69	.56	.42
Phosphorus	.43	.56	.39
Diet			
Dry matter	58.1	52.4	43.7
Crude protein	16.4	17.2	17.3
Neutral detergent fiber	30.3	36.9	36.0
Acid detergent fiber	18.0	19.8	19.3

[1]Source: Paulson, Ehle, Otterby, and Linn, 1987, University of Minnesota.

Dry matter and nutrient composition of alfalfa, triticale, and oat forages used are listed in table 4. The researchers indicated the recommended dry matter content of small grains at ensiling is approximately 40 percent. Triticale was near the recommended dry matter content, but oat was harvested under poor conditions and ensiled at a lower dry matter than desired. Crude protein con-

tent was highest in the alfalfa forage, intermediate in triticale, and lowest in the oat forage. The researchers indicated that a partial explanation for the higher crude protein content in the triticale than the oat forage was that 92 pounds of supplemental nitrogen were applied per acre to the triticale but not to oat. Acid detergent fiber values were similar for all three forages but neutral detergent fiber values were higher in triticale and oat forage than in alfalfa. The bottom of table 4 shows the composition of the total mixed diet (forage and grain mixture) used in the study.

Table 5. Effect of forage on milk yield and milk composition[1]

Item	Dietary treatment		
	Alfalfa	Triticale	Oat
No. of cows	15	15	12
Milk yield and composition			
3.5% FCM[2] (lb/cow/day)	64.7[ab]	71.9[a]	60.7[b]
fat, %	3.7	3.7	3.9
protein, %	3.4	3.4	3.4
total solids, %	13.3	13.3	13.4

[1]Source: Paulson, Ehle, Otterby and Linn, 1987, University of Minnesota.
[2]Fat-corrected milk.
[ab]Means differ ($P<.05$).

Cows fed the diets containing triticale produced significantly more 3.5 percent fat-corrected milk (FCM) than cows fed the diet containing oat forage (table 5). Milk production of cows fed the diet containing alfalfa was intermediate. Milk fat, protein, and total solids percentages were not affected by forage source. Dry matter intake of cows fed the triticale and alfalfa forage diets were similar and higher than the dry matter intake of cows fed the oat forage diet. According to the researchers, the lower dry matter content of the oat forage diet may have affected intakes and influenced milk production.

From this study these researchers concluded that small grain silages can be used as the sole forage for lactating cows if silages are cut at early maturities and harvested at proper moisture levels. Cows fed triticale were similar to cows fed alfalfa in milk production, milk composition, and dry matter intake.

An excellent summary of the chemical composition and uses of triticale up to 1982 was written by Klaus Lorenz. See Lorenz, Klaus. 1982 "Triticale processing and utilization: Comparison with other cereal grains" in *CRC Handbook of Processing and Utilization in Agriculture:* Wolff, I., Ed. Vol. II: Part I, Plant Products, pp. 277-327.

VARIETIES, YIELD, AND WINTER SURVIVAL

Both winter and spring triticale varieties are available; however, the winter hardiness of the winter varieties is less than that of winter rye. During less severe winters (early snow cover), winter varieties have survived in Minnesota. There are a number of spring triticale varieties, but yield comparisons are available on only a few of the recent varieties. Grain yield comparisons during 1981-86 from North Dakota indicated that the North Dakota-released varieties, Karl and Kramer, yielded similar to both the hard red spring wheats, Era and Len, and the durum wheats, Cando and Vic, at Langdon, in northeastern North Dakota (table 6). In 1986 however, the hard red spring wheat variety, Wheaton, yielded more than either triticale. During 1982-83, Karl and Kramer yielded more than Era, Len, and Cando, but less than Vic at Casselton, located just west of Fargo. The triticale varieties, Karl and Kramer, represent good choices of high yielding spring triticales available for Minnesota.

Table 6. Grain yields of spring triticales and wheat in North Dakota, 1981-86[1]

Variety	Origin	Crop	Langdon		Casselton
			81, 83	86	82-83
			lb/A		
Karl	ND	Triticale	3315	2148	3152
Kramer	ND	Triticale	3355	2677	3175
Era	MN	HR spring wheat	3200	—	2695
Len	ND	HR spring wheat	2805[2]	—	2765
Wheaton	MN	HR spring wheat	—	2889	—
Cando	ND	Durum wheat	2550	—	2722
Vic	ND	Durum wheat	3156[2]	—	3485

[1] Source: North Dakota Extension Agronomy Circular No. 1.
[2] 1983 only; yields adjusted for comparison.

Table 7. Agronomic data for spring triticale and wheat varieties in North Dakota, 1981-83[1]

Variety	Crop	Days to heading	Plant height	Test weight[2]	Leaf rust[3]	Grain protein
			- cm -	lb/bu		...% ..
Karl	Triticale	58	79	47.1	10-15 MR-MS	13.1
Kramer	Triticale	58	92	45.5	10 MR	13.3
Era	HR spring wheat	64	75	56.7	Tr MR-MS	14.3
Len	HR spring wheat	62	80	57.5	2-5 MS	14.8
Cando	Durum wheat	64	75	57.0	0	13.8
Vic	Durum wheat	62	95	60.0	0	14.0

[1] Source: North Dakota Extension Agronomy Circular No. 1.
[2] Test wt of triticale = 50, Wheat = 60 lb/bu.
[3] More severe rating in 1982.

Table 7 compares the agronomic characteristics of Karl and Kramer with hard red spring and durum wheat. The triticale varieties are 4-6 days earlier and have more leaf rust susceptibility than hard red spring and durum wheat. Both varieties are susceptible to ergot, but are less so than many of the earlier triticale varieties. Comparable data for Nutricale, a spring variety available from Nutriseeds, Perham, MN, are not available. However, at Staples in 1986 Nutricale yielded 1810 lb/A compared to Rymin winter rye which yielded 2912 lb/A. The yield range for Nutricale in Minnesota has been from 1250 to 4000 lb/A.

Yield and survival data for winter triticale are limited because of its poor winter survival in North Dakota and Minnesota. Table 8 shows winter triticale yield data when early snow cover occurred in 1985-86.

Table 8. Yield of winter triticale, rye and wheat, 1986

Variety	Origin	Crop	Location	
			Williston, ND[1]	Staples, MN[2]
			lb/A	
I-18	Nutriseed	Triticale	1963	2965
239	Nutriseed	Triticale	—	1960
Double Crop	Nutriseed	Triticale	1937	1505
Rymin	MN	Rye	—	3013
Puma	Canada	Rye	2244	—
Northstar	Canada	Wheat	1876	—
Rose	SD	Wheat	1951	—

[1] Source: North Dakota Extension Agronomy Circular No. 1.
[2] Source: Meredith and Weins, 1987, University of Minnesota.

Two varieties of winter triticale, I-18 and Double Crop, yielded about the same as the winter wheats, Northstar and Rose, but less than Rymin rye at Staples, Minnesota on irrigated sandy soil. I-18 yield was comparable to Rymin rye but the other two varieties, 239 and Double Crop, yielded much less than Rymin rye. Table 9 shows the agronomic data for I-18 and Double Crop.

Table 9. Agronomic data for winter triticale, wheat and rye varieties, Williston, ND, 1986

Variety	Crop	Days to heading	Height	Test weight
I-18	Triticale	34	34	51
Double Crop	Triticale	41	41	51
Puma	Rye	28	37	55
Northstar	Wheat	42	30	61
Rose	Wheat	37	26	60

[1] Source: North Dakota Extension Agronomy Circular No. 1.

Limited North Dakota winter survival data indicate that 239 and Double Crop are more winter hardy than I-18. Generally, winter triticale will not survive Minnesota winters unless special care is taken to leave field residue (as for winter wheat) to catch snow and provide cover. Also winter triticales are more susceptible to injury from early spring freezing temperatures than winter rye.

CULTURAL PRACTICES

PLANTING DATE AND RATE—Spring triticale varieties, as other small grains, should be planted as early as practical. The planting rate should be 28 viable seeds per square foot in a seed bed prepared as for wheat. Winter varieties should be planted in the fall on dates similar to winter wheat but even more care should be taken to leave surface residue to catch snow.

HERBICIDES—Bromoxynil (Buctril) is registered for broadleaf weed control in triticale, however no herbicides are registered for grass weed control so the crop needs to be planted on relatively weed-free fields. Triticale grows slower than wheat in the spring and grassy weeds could be a problem.

FERTILIZER—Phosphorus must be adequate for good yields and triticale uses more nitrogen than wheat.

DISEASES—Ergot is the most serious disease of triticale and can cause grain palatability problems as well as health problems in animals. Avoid planting triticale two years on the same field or following rye. Leaf rust is more severe on triticale than on the more resistant hard red spring wheat varieties. No fungicides are cleared for use on triticale.

HARVESTING—Harvest is about one week later than wheat and it threshes easily when dry. Swathing is recommended. The cylinder and forward speed of the combine should be slower than for wheat. The concaves should be more open and the air less open than when combining for wheat. Post harvest dormancy is less than hard red spring wheat, similar to durum, so harvesting needs to be timely to avoid sprouting.

MARKETS

In 1987 there were about 10,000 acres of triticale planted in North Dakota, Minnesota, and Wisconsin. Some elevators such as the Farm Service Elevator in Willmar, MN have been paying a slight premium above No. 2 yellow corn on a weight basis at 14 percent moisture: triticale tests out at 50 lbs/bu. **Markets are limited and should be obtained before triticale is planted as a cash crop.**

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Center for Alternative Crops & Products

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