New Wheat Varieties

ORCF-102

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CLEARFIELD® Soft White Winter Wheat

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Variety description

'ORCF-102' is a common soft white winter wheat developed by Oregon State University and the BASF Corporation in cooperation with the USDA-ARS. It is an awned, short-statured, semidwarf variety with high yield potential and midseason maturity.

ORCF-102 is resistant to Pseudocercosporella strawbreaker (eyespot) foot rot and current races of stripe rust (*Puccinia striiformis*). It is also moderately resistant to *Cephalosporium* stripe and *Fusaruim* crown rot (dryland foot rot).

ORCF-102 is a non-GM (genetically modified) wheat variety that carries an altered form of the acetolactate synthase (also known as acetohydroxyacid synthase) enzyme. The altered enzyme is not affected by imazamox, the active ingredient in Beyond™ herbicide and one of the active ingredients in Clearmax™ herbicide. When ORCF-102 is used in combination with Beyond or Clearmax at labeled rates, the CLEARFIELD® technology provides growers with an effective tool for control of several grassy weeds.

Area of adaptation

ORCF-102 is best adapted to dryland and irrigated wheat-growing regions in northeast Oregon and southeast Washington (Figure 1, blue-shaded regions).

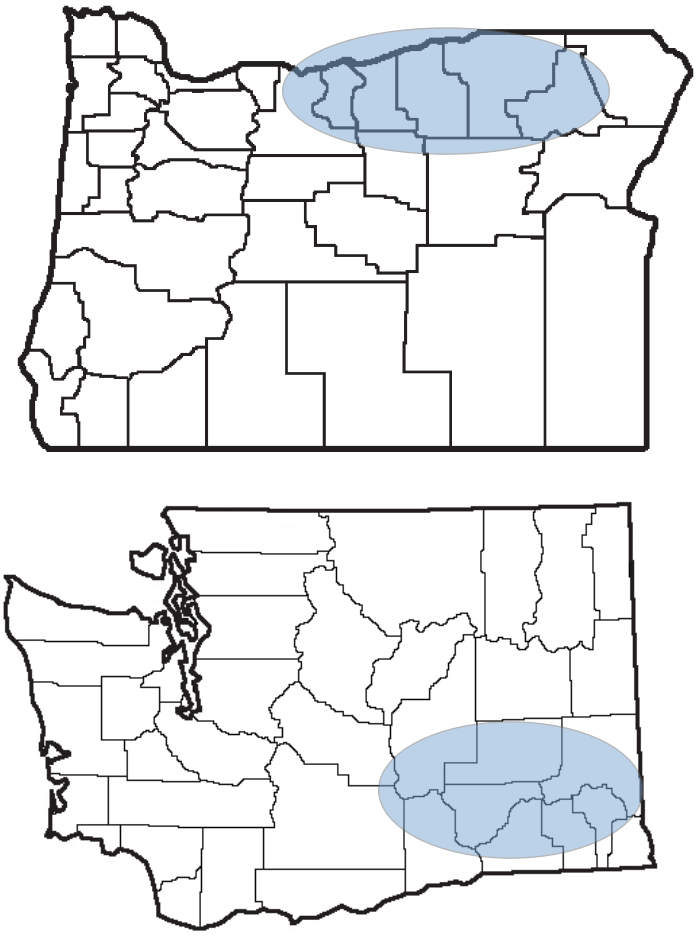

Figure 1. ORCF-102 is best adapted to dryland and irrigated wheat-growing regions in northeast Oregon and southeast Washington (blue-shaded regions).

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Year released

ORCF-102 was released in 2004 and is protected under the Plant Variety Protection Act with the Title 5 option. ORCF-102 was released through Oregon State University's nonexclusive CLEARFIELD variety licensing program.

Agronomic characteristics

Height and lodging resistance

In trials over 22 site-years in Oregon and 37 site-years in Washington, the plant height of ORCF-102 averaged 36.3 and 36.2 inches, respectively. Height is similar to that of Tubbs, Tubbs-06, and Eltan and approximately 2 to 3 inches taller than Stephens, Madsen, and ORCF-101

Figure 2. ORCF-102 wheat.

Table 1. Grain yield and agronomic data for 11 soft white winter wheat varieties grown across a range of environments in Oregon, 2005–2007.

	Grain yield				Agronomic data			
	Northeast Oregon		OWEYT*		Test weight	Grain protein	Plant height	Heading date
Variety	2-year mean 16 site-years (bu/ac)	3-year mean 22 site-years (bu/ac)	2-year mean 24 site-years (bu/ac)	3-year mean 34 site-years (bu/ac)	2-year mean 24 site-years (lb/bu)	2-year mean 22 site-years (%)	2-year mean 22 site-years (in)	2-year mean 8 site-years (DOY)**
ORCF-102	*84.7*	*83.6*	*92.0*	*90.7*	*60.2*	*9.8*	*36.3*	*145.7*
Brundage 96	80.8	81.1	88.8	89.0	59.1	9.5	33.2	145.4
Gene	71.5	76.1	78.0	83.3	57.9	10.5	30.4	141.6
Goetze	77.1	79.3	87.7	91.4	58.9	9.7	31.8	141.9
Madsen	75.9	77.0	84.9	86.0	59.2	10.3	34.1	147.5
Masami	81.7	80.8	89.6	88.9	58.7	9.4	35.8	148.7
ORCF-101	76.4	78.8	84.0	85.8	59.2	10.1	34.1	145.5
Stephens	77.0	79.0	86.6	87.6	59.0	10.1	33.7	144.3
Tubbs	80.6	80.3	89.8	90.4	58.7	9.6	36.7	146.1
Tubbs-06	82.2	—	91.8	—	58.8	9.6	37.0	145.7
Westbred 528	83.3	83.9	90.7	92.1	60.8	9.9	33.9	142.9
Mean	79.2	80.0	87.6	88.5	59.1	9.9	34.3	145.0
LSD (0.05)***	3.2	2.7	3.2	2.6	0.4	0.3	0.6	0.7
CV (%)	10.3	9.9	11.2	10.8	2.1	7.0	4.9	0.9

*Oregon Winter Elite Yield Trial

**Day of year

***Least significant difference

(Tables 1 and 2). Straw strength of ORCF-102 is good, and lodging has not been observed in any production environment.

Maturity

ORCF-102 is a midseason-maturing variety, similar to Tubbs, Tubbs-06, and ORCF-101. It heads approximately 2 days earlier than Madsen and 1 or 2 days later than Stephens (Tables 1 and 2).

Vernalization and cold tolerance

ORCF-102 is a winter wheat that requires vernalization to initiate flowering. Results from crown freezing tests (a measure of cold tolerance) conducted by the USDA-ARS have shown that the cold tolerance of ORCF-102 is similar to that of Tubbs, Tubbs-06, Madsen, and Masami (Table 3, page 4). Under normal conditions, growers in northeast Oregon and southeast Washington are unlikely to observe winter injury.

Table 2. Grain yield and agronomic data for 10 soft white winter wheat varieties grown across a range of environments in Washington, 2005–2007.

	Grain yield				Agronomic data			
	WSU variety trials south of Highway 2		WSU variety trials		Test weight	Grain protein	Plant height	Heading date
Variety	2-year mean 30 site-years (bu/ac)	3-year mean 44 site-years (bu/ac)	2-year mean 37 site-years (bu/ac)	3-year mean 55 site-years (bu/ac)	2-year mean 37 site-years (lb/bu)	2-year mean 37 site-years (%)	2-year mean 37 site-years (in)	2-year mean 37 site-years (DOY)*
ORCF-102	*105.8*	*110.2*	*105.3*	*108.4*	*59.9*	*11.3*	*36.2*	*152.6*
Brundage 96	99.5	103.1	101.7	103.8	58.5	11.1	33.3	152.5
Eltan	97.3	96.0	99.3	97.7	59.3	11.2	36.2	157.0
Madsen	98.2	103.0	98.4	102.1	59.1	11.6	34.6	154.9
Masami	101.7	104.3	102.0	104.5	58.1	10.9	35.3	156.4
ORCF-101	95.7	102.0	96.2	101.3	59.1	11.7	34.3	152.1
Stephens	98.0	102.5	97.7	101.1	58.9	11.4	32.8	150.6
Tubbs	107.5	111.2	107.5	110.4	58.5	10.8	36.1	152.5
Tubbs-06	102.9	—	103.7	—	58.3	11.1	36.4	153.1
Westbred 528	100.0	102.8	101.1	102.4	60.8	11.3	33.5	149.4
Mean	100.7	103.9	101.3	103.5	59.0	11.2	34.9	153.1
LSD(0.05)**	2.7	2.4	2.4	2.1	0.2	0.2	0.4	0.3
CV (%)	10.7	11.0	10.5	10.9	1.7	6.8	4.7	0.8

*Day of year

**Least significant difference

Disease resistance

ORCF-102 is resistant to strawbreaker (eyespot) foot rot and current races of stripe rust. It is also moderately resistant to leaf rust, *Fusarium* crown rot (dryland foot rot), and *Cephalosporium* stripe. ORCF-102 is moderately susceptible to Septoria leaf blotch and snow mold (Table 3). A fungicide seed treatment is recommended to control common bunt and other seed-borne diseases.

Yield

ORCF-102 has been shown to have very high yield potential across a range of environments in Oregon and Washington. Across 34 site-years of OSU variety testing, ORCF-102 averaged 90.7 bushels per acre, compared to 90.4, 87.6, 85.8, 86.0, and 92.1 bushels per acre for Tubbs, Stephens, ORCF-101, Madsen, and Westbred 528, respectively (Table 1). Similarly, in 55 site-years of WSU variety testing, ORCF-102 averaged 108.4 bushels per acre, compared to 110.4, 101.1, 101.3, 102.1, and 104.5 bushels per acre for Tubbs, Stephens, ORCF-101, Madsen, and Masami, respectively (Table 2).

In northeast Oregon, where it is particularly well adapted, ORCF-102 averaged 83.6 bushels per acre, similar to Westbred 528 and Tubbs-06 (Table 1). In this region, ORCF-102 averaged 2 to 5 bushels per acre more than Brundage 96, Goetze, Masami, and Stephens. Similarly,

Table 3. Agronomic and disease ratings for 12 soft white winter wheat varieties grown in Oregon and Washington.

Variety	Maturity	Winter hardiness*	Rust**		Septoria**	Crown rot**	*Cephalosporium* stripe**	Strawbreaker foot rot** *Pseudocercosporella*
			Stripe	Leaf				
ORCF-102	*Midseason*	*4*	*R/MR*	*MR*	*MS*	*MR/MS*	*MR/MS*	*R*
Brundage 96	Midseason	5	MR	MS	S	MR	MR/MS	S
Eltan	Mid–late	10						
Gene	Early	2	MR/MS	S	S	MR	MS	MS/MR
Goetze	Early–mid	2	R	MR	MR	MR/MS	MS	MR
Madsen	Midseason	5	R	MR	MS	MR/MS	MR	R
Masami	Midseason	5	MS	—	S	MR	MR/MS	—
ORCF-101	Midseason	3	MS	MS	MS	MS/MR	S	S
Stephens	Early–mid	3	R	S	S	S	S	S
Tubbs	Midseason	5	MS	MS	MS	S	S	R
Tubbs-06	Midseason	5	MR/MS	MS	MS	S	S	R
Westbred 528	Early–mid	4	MS	MS	S	MR	S	S

*Scale: 1–10 (10 = excellent; 1 = poor)

**R = resistant; MR = moderately resistant; MS = moderately susceptible; S = susceptible

Data were compiled from the following sources: *Winter Grain Varieties for 2003*, Special Report 775, Oregon State University Extension Service; 2004 through 2007 *Oregon Winter Elite Yield Trial Disease Ratings*; and *Variety Characteristics*, Washington State Crop Improvement Association.

in southeast Washington south of Highway 2, ORCF-102 averaged 110.2 bushels per acre, similar to Tubbs and 6 to 14 bushels per acre more than Brundage 96, Eltan, Madsen, Masami, ORCF-101, Stephens, and Westbred 528 (Table 2).

Test weight and quality

Test weight of ORCF-102 averaged 60.2 pounds per bushel across 24 site-years in Oregon and 59.9 pounds per bushel across 37 site-years in Washington. These test weights are similar to those for Westbred 528. Test weight of ORCF-102 was approximately 1 to 1.5 pound per bushel more than Brundage 96, Eltan, Madsen, Masami, ORCF-101, and Tubbs or Tubbs-06.

Grain protein of ORCF-102 averaged 9.8 percent in Oregon and 11.3 percent in Washington, similar to Stephens, Madsen, Tubbs or Tubbs-06, and Westbred 528.

Milling and baking evaluations from the USDA-ARS Western Wheat Quality Laboratory and the PNW Wheat Quality Council suggest that ORCF-102 is similar to Stephens and acceptable for a soft white winter wheat. Grain hardness values for ORCF-102 averaged 5 points higher than Stephens and 4 points less than Tubbs, when measured with the Pertin Single Kernel Characterization System (SKCS). Average break flour yields were similar to those for Stephens and Tubbs. Cookie baking performance was similar to Stephens, and average cookie spread was 0.13 millimeter wider than Tubbs (Table 4). Flour swelling volume tests suggest ORCF-102 has normal starch properties.

Development

ORCF-102 was derived from the three-way cross 'Madsen'/'CV-9804'// 'Weatherford' made in 1996 and 1997 at the OSU Hyslop Field Research Farm. CV-9804, also known as 'FS-4', is the donor of the CLEARFIELD trait developed through mutagenesis of the cultivar 'Fidel'. ORCF-102 is an F_2-derived line, identified as a single plant in 1999 when it was

Table 4. End-use quality analyses of ORCF-102 soft white winter wheat in paired comparisons with Stephens and Tubbs.

Variety	Kernel hardness (SKCS)*	Break flour yield (%)	Flour yield (%)	Flour ash (%)	Milling score	Flour protein (%)	Mix absorption (%)	Cookie diameter (mm)
ORCF-102	*42.3***	*48.4*	*69.3*	*0.42*	*82.5*	*9.2*	*55.5*	*9.29*
Stephens	35.9	48.1	69.9	0.42	83.6	9.7	55.8	9.28
ORCF-102	*43.0*	*48.4*	*69.0*	*0.42*	*82.4***	*8.7*	*55.8*	*9.34***
Tubbs	45.5	48.3	69.0	0.45**	80.5	8.6	55.7	9.21

*Single Kernel Characterization System

**Indicates a statistically significant increase ($p < 0.05$), based on a paired t-test.

Data provided by USDA-ARS Western Wheat Quality Laboratory, Pullman, Washington.

selected from a bulk plot at the Columbia Basin Agricultural Research Center, Pendleton, Oregon. The selection was evaluated under the experimental number OR2010007.

Seed availability

Breeder and Foundation seed will be maintained by the Washington State Crop Improvement Association (WSCIA). ORCF-102 is protected under U.S. Plant Variety Protection with the Title 5 option (PVP 200500337). Certification classes recognized for ORCF-102 include Foundation, Registered, and Certified. Seed stocks that fail to meet certification standards cannot be sold as seed, nor used as seed.

Foundation and Registered seed stocks may be sold only to those granted a license by OSU. Certified seed will be produced and sold only under nonexclusive license with Oregon State University. Certified seed stocks may be used to plant a single commercial crop and may not be used to generate seed stocks for replanting. A signed BASF CLEARFIELD wheat stewardship grower agreement is required prior to purchasing seed for planting.

Seed of ORCF-102 has been deposited in the USDA National Small Grains Collection, Aberdeen, Idaho. It is requested that the source of this material be acknowledged in future use by wheat breeding and genetics programs.

Acknowledgments

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Variety development team

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Management guidelines

Planting date

The disease resistance of ORCF-102 makes it a good choice for plantings across a wide range of dates in Oregon. In early plantings, the incidence of diseases such as *Fusarium* crown rot, strawbreaker (eyespot) foot rot, and *Cephalosporium* stripe—as well as insect-vectored diseases such as Barley Yellow Dwarf Virus—increases. ORCF-102 is resistant or moderately resistant to many of these diseases, including strawbreaker (eyespot) foot rot, *Fusarium* crown rot, and *Cephalosporium* stripe. Thus, ORCF-102 is a good choice for plantings prior to October 1. In September plantings, studies conducted in 2006 and 2007 found that yields of ORCF-102 were similar to those of Tubbs-06 and 2 to 12 bushels per acre greater than Stephens, Madsen, ORCF-101, and Goetze (Table 5).

In "on-time" plantings, ORCF-102 has shown high yield potential across a wide range of environments in Oregon and Washington. Plantings in early to mid-October are considered "on-time" for much of Oregon.

In late plantings, yields of all varieties are reduced compared to "on-time" plantings. However, ORCF-102 is a particularly good choice for late plantings. In late plantings, studies have shown that yields of ORCF-102 are similar to those of Goetze, Tubbs, or Tubbs-06 and 6 to 14 bushels per acre greater than ORCF-101, Stephens, and Madsen (Table 5). In addition to increased yield, ORCF-102 maintains higher test weight in late plantings, compared to Stephens, Tubbs, Tubbs-06, Madsen, ORCF-101, and Goetze.

Table 5. Grain yield of seven soft white winter wheat varieties in a planting date study at Pendleton, Oregon, 2006–2007.

Planting date	Stephens (bu/ac)	Madsen (bu/ac)	Tubbs (bu/ac)	Tubbs-06 (bu/ac)	ORCF-101 (bu/ac)	ORCF-102 (bu/ac)	Goetze (bu/ac)	Skiles (bu/ac)	$LSD_{(0.05)}$* (bu/ac)
2006									
September 12	81.7	86.6	103.9	—	88.9	93.3	83.9	—	10.0
October 3	91.7	101.2	102.4	—	98.7	105.9	105.6	—	8.8
October 27	78.1	69.4	79.5	—	72.4	84.8	79.4	—	5.6
November 20	83.6	74.8	89.1	—	78.6	88.7	88.7	—	6.8
2007									
September 12	81.7	—	—	83.3	82.1	84.1	80.7	78.9	11.5
October 3	80.9	—	—	76.7	79.9	75.5	84.5	82.0	12.2
October 27	70.9	—	—	72.0	66.9	66.7	71.1	72.7	10.7
November 20	48.0	—	—	62.2	49.0	57.8	62.1	55.0	7.1

*Least significant difference

Seeding rate

The recommended seeding rate for soft white winter wheat in Oregon is 22 seeds per square foot. For late-planted wheat, it is recommended that the seeding rate be increased to 33 seeds per square foot. Seeding rate trials have confirmed that these general recommendations are valid for ORCF-102. Increased seeding rates in late plantings resulted in a yield increase of 2 to 11 bushels per acre for ORCF-102 (Table 6).

Seeding rates for most equipment are adjusted in pounds per acre. To avoid heavy or light plantings, it is important to determine the proper seeding rate using the number of seeds per pound. Conversions for a range of seeds per pound are found in Table 7.

The number of seeds per pound depends on seed size and varies depending on variety, production environment, and year. Research has shown that ORCF-102 has a high kernel weight, and the number of seeds per pound is similar to Stephens and greater than Tubbs or Tubbs-06. Seeds per pound may be obtained from your seed dealer or can be determined by weighing a 50-seed sample and using Table 7.

Table 6. Grain yield of ORCF-102 across three seeding rates at Moro and Pendleton, Oregon, 2007.

	Seeding rate (seeds/ft²)			
Planting date	11 (bu/ac)	22 (bu/ac)	33 (bu/ac)	$LSD_{(0.10)}$* (bu/ac)
Moro				
October 3	83.6	94.7	92.1	13.8
October 27	68.4	73.1	71.3	19.2
November 20	57.2	60.6	71.6	11.6
Pendleton				
October 3	78.9	83.0	77.8	8.4
October 27	65.9	71.2	73.0	6.9
November 20	51.1	52.2	63.6	6.2

*Least significant difference

Table 7. Seeding rate conversion from seeds per square foot to pounds per acre.

		Seeding rate	
Seeds per pound	Weight of 50-seed sample (g)	Pounds per acre needed for 22 seeds/ft²	Pounds per acre needed for 33 seeds/ft²
8,000	2.84	120	180
9,000	2.52	106	160
10,000	2.27	96	144
11,000	2.06	87	131
12,000	1.89	80	120
13,000	1.75	74	110
14,000	1.62	68	103
15,000	1.51	64	96

Fertility

ORCF-102 has been grown across a wide range of environments, and no special fertility requirements have been observed. Therefore, it is recommended that growers follow the recommended fertility guidelines for soft white winter wheat in their area.

Herbicide applications

Postemergence applications of Beyond or Clearmax may be made in the fall/winter or in spring after tiller initiation but before jointing. Rates are as follows:

- Beyond (imazamox): 4–6 oz/acre of product (0.031–0.047 lb ai/acre)
- Clearmax (imazamox + MCPA ester co-pack): 4–6 oz/acre Beyond + 8–12 oz/acre (0.23–0.35 lb ae/acre) MCPA ester

Observe the following precautions regarding tank mixing:

- Beyond and Clearmax applications require the addition of a nonionic surfactant (0.25% vol/vol) and a liquid nitrogen fertilizer (2.5 gal/100 gal of spray solution) or ammonium sulfate solution (12–15 lb/100 gal of spray solution) to the spray mixture.
- Do not use crop oil concentrate or methylated seed oil surfactants when making Beyond applications to ORCF-102, as these mixtures will injure wheat plants.
- Beyond may be applied in a liquid fertilizer carrier as long as the liquid fertilizer/water solution is at least 50 percent water.
- Do not tank mix Beyond and Clearmax with Group 2 sulfonylurea herbicides, as unacceptable wheat injury may result.
- Review current Beyond and Clearmax labels for recommended tank mixture partners and mixing instructions.

Beyond and Clearmax will control or suppress many problem grass weed species in wheat production cropping systems, including jointed goatgrass, downy brome, and feral rye, as well as many broadleaf weeds. Apply Beyond or Clearmax to actively growing grass weeds in the 4–5 leaf stage and to broadleaf weeds that are less than 3 inches tall. Refer to the weed control tables on the Beyond and Clearmax labels for more specific information on application timings (including fall timings) and recommended tank mixtures for specific problem weeds, including feral rye, Italian ryegrass, wild oat, and kochia.

Do not apply Beyond or Clearmax when cold, wet weather is expected within 1 week following application. Reduced weed control efficacy and crop injury may occur when maximum daytime temperatures are less than 40°F after application.

Further information on optimizing weed control utilizing CLEARFIELD technology may be found in the following:

- *PNW Weed Management Handbook*
- *Weed Management in Clearfield Wheat with Imazamox,* EM 8833

Both publications are available online at *http://extension.oregonstate.edu/catalog/*

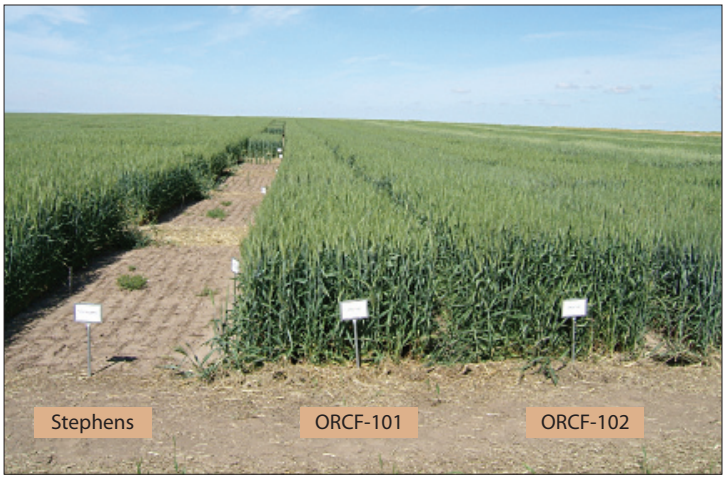

Figure 3. Stephens, ORCF-101, and ORCF-102 after application of Beyond herbicide.

Table 8 lists the plant-back restrictions for some common rotation crops that could follow ORCF-102 wheat in Oregon. Before planting ORCF-102 and making applications of Beyond or Clearmax, review the most current labels for the full list of crop rotational intervals to ensure that future crop rotation goals can be achieved. Herbicide label changes are common, and plant-back restrictions are adjusted frequently to reflect the effects of cropping system management (e.g., tillage and irrigation practices) on the potential for herbicide carryover in specific regions.

Table 8. Partial listing of rotational crop plant-back intervals following Beyond and Clearmax applications.

Plant-back interval (months)	Crop(s)
0	CLEARFIELD wheat, CLEARFIELD sunflower, CLEARFIELD canola, dry beans, dry peas
3	Alfalfa, wheat (non-CLEARFIELD)
4	Cereal rye
8.5	Corn (CLEARFIELD and non-CLEARFIELD pop, sweet, field, and seed)
9	Barley[1], oat, onion, sunflower, peanut, watermelon
18	Barley[1], carrot, potato
26	Canola, condiment mustards, sugar beet, table beet

[1] See Beyond or Clearmax labels for soil pH, tillage system, and cumulative rainfall and/or irrigation requirements that most closely approximate your production system to determine the appropriate barley plant-back interval.

Some oilseed crops newer to the region, such as safflower or camelina, are not currently listed on the labels. Plant-back intervals for these crops have yet to be determined, but are likely to be greater than 18 months and perhaps as long as 26 months.

Herbicide resistance management is a key consideration when utilizing CLEARFIELD technology. Maintaining the utility of ALS-inhibiting Group 2 herbicides in wheat production cropping systems is crucial for increasing the longevity of this production technology. Thus, Oregon State University strongly advocates that growers follow the BASF stewardship recommendations outlined in the CLEARFIELD Wheat Stewardship Guide. These recommendations include the following:

- Do not plant ORCF-102 or any other CLEARFIELD wheat variety continually and apply Beyond or Clearmax more than 2 out of every 4 years.
- Limit the reliance on ALS-inhibiting herbicides. When applicable, use herbicides with different modes of action.
- Properly manage weeds in wheat–fallow–wheat rotations.
- Treat the entire field with a labeled rate of Beyond or Clearmax for jointed goatgrass control.
- Control jointed goatgrass in fence rows, road ditches, and pastures around CLEARFIELD wheat fields.

In addition, the following publications outline strategies for slowing or preventing the development of herbicide-resistant weed populations:

- *Management Strategies for Preventing Herbicide-Resistant Grass Weeds in Clearfield Wheat Systems*, PNW 572. http://info.ag.uidaho.edu/pdf/PNW/PNW0572.pdf
- *Herbicide-Resistant Weeds and Their Management*, PNW 437. http://info.ag.uidaho.edu/pdf/PNW/PNW0437.pdf

There are no restrictions on grazing or feeding wheat forage following applications of Beyond. Do not graze or feed wheat forage to meat or dairy animals for 7 days following applications of Clearmax.

Fungicide applications

A fungicide application is unlikely to be necessary when growing ORCF-102. However, no sensitivity to current fungicides is known. When applying fungicides, follow label directions and all applicable state and federal regulations.

Yield components

Wheat yield consists of three components: head number, kernels per head, and kernel weight. Both head number and kernels per head are determined early in wheat development, at Feekes 2–5. Kernel weight is determined later in the growing season, at Feekes 10.1–10.5.

Although environment plays an important role in yield, genetic factors heavily influence the ways in which the three components combine to determine yield. Total grain yield of ORCF-102 is determined more by factors influencing head number and kernel weight than by head size and head fertility. Compared to widely grown varieties such as Tubbs and Stephens, ORCF-102 is characterized by average head numbers, small head size, average head fertility, and high average kernel weights (Table 9).

Table 9. Yield component comparison of ORCF-102, Stephens, and Tubbs/Tubbs-06.

Yield component	Variety comparison
Head number	ORCF-102 = Tubbs/Tubbs-06 < Stephens
Head size	Stephens = ORCF-102 < Tubbs/Tubbs-06
Head fertility	Tubbs/Tubbs-06 = ORCF-102 ≤ Stephens
Kernel weight	Tubbs/Tubbs-06 < Stephens = ORCF-102

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