UFSMFW 2202 - Early black oat cultivar for ground cover

Volmir Sergio Marchioro[1]*, Daniela Meira[2], Luís Antônio Klein[1], Carine Meier[3], Velci Queiróz de Souza[4], Diego Nicolau Follmann[5], Ivan Ricardo Ricardo Carvalho[6], Braulio Otomar Caron[5], Denise Schimidt[5], Maicon Nardino[7] and Tiago Olivoto[8]

Abstract: *UFSMFW 2202 is an early black oat cultivar with high dry matter and grain yield potential. When used in rotation systems, the early cycle has the immediate advantage of allowing anticipated sowing of subsequent crop. Initially, the cultivar is recommended for the North and Northwest of Rio Grande do Sul.*

INTRODUCTION

One of the winter cereals planted in Brazil is black oat (*Avena strigosa* Schreb.). In southern Brazil, this oat is an essential element of crop production systems, to cover the ground, as forage or for grain production (Leite et al. 2012), and it also plays an important role in no-tillage systems for seeding on mulch.

The main use of this crop is as ground cover, to improve the soil chemical, physical and biological properties in the period before summer crop sowing. According to Melo et al. (2011), the dry matter yield potential and soil nutrient extraction of black oat are outstanding and can benefit subsequent crops. As reported by Carneiro et al. (2008), ground cover crops are essential to protect the soil against erosion and to suppress weeds.

Among several other requirements, black oat cultivars should have early vegetative and reproductive cycles, as well as high dry matter and grain yield potential. In view of the relevance of black oat, the Research Group for Plant Breeding (GPMP) of the Federal University of Santa Maria (UFSM) initiated the selection of early cultivars with high dry matter and grain yield on the Campus Frederico Westphalen, Rio Grande do Sul.

BREEDING METHODS

The new black oat cultivar UFSMFW 2202 was developed from seeds of field plants, followed by generations of selection.

In 2013, seeds from field plant populations were collected and labelled according to the 14 locations of origin (Taquaruçu do Sul, Cunha Porã, Palmeira das Missões 1, Palmeira das Missões 2, Condor, Alto Alegre, Campos Borges, Chapada, Boa Vista das Missões, Salvador das Missões, Santa Rosa, Espumoso, Planalto, Ajuricaba).

*Corresponding author:
E-mail: volmir@marchioro.eng.br
ORCID: 0000-0003-3873-9567

[1] Universidade Federal de Santa Maria, Campus Frederico Westphalen, Rua Sete de Setembro, s/n, 98400-000, Frederico Westphalen, RS, Brazil
[2] Centro de Ensino Superior Riograndense, Rodovia Leonel de Moura Brizola, BR 386, km 138, Beira Campo, 99560-000, Sarandi, RS, Brazil
[3] Escola Estadual Técnica Celeste Gobbato, BR 158, km 106, Interior, 98300-000, Palmeira das Missões, RS, Brazil
[4] Universidade Federal do Pampa, BR 290, 423, Universitário, 97300-000, São Gabriel, RS, Brazil
[5] Universidade Federal de Santa Maria, Avenida Roraima, 1000, Cidade Universitária, Camobi, 97105-900, Santa Maria, RS, Brazil
[6] UNIJUI, Rua do Comércio, 3000, Universitário, 98700-000, Ijuí, RS, Brazil
[7] Universidade Federal de Viçosa, Avenida Peter Henry Rolfs, s/n, Campus Universitário, 36570-900, Viçosa, MG, Brazil
[8] Universidade Federal de Santa Catarina, Rua Engenheiro Agronômico Andrei Cristian Ferreira, s/n, Trindade, 88040-900, Florianópolis, SC, Brazil

In 2014, the populations were cultivated at low density in field trials, in an experimental area of UFSM in Frederico Westphalen/RS (lat 27° 39' S, long 53° 42' W, alt 461 m asl). The plots consisted of six 5-m long rows spaced 0.17 m apart. The best plants were selected (second generation) by the pedigree method, for agronomic traits such as early cycle, low plant height and grain yield potential. Each plant was harvested and threshed separately and the seeds sown in a single row in the field in 2015.

The best lines and of these the best plants were selected for the target traits (third generation). The head of each selected plant was hand threshed separately, the seeds sown in a single row (head row) again (pedigree method) in 2016 and the plants evaluated and selected. Cultivar UFSMFW 2202 was derived from one of the head rows evaluated in that year, from the population collected in Chapada.

TRAITS AND PERFORMANCE

In 2017, a line with the experimental name UFSMFW 2-07 was tested in preliminary trials on the experimental area of UFSM, in Frederico Westphalen/RS (lat 27° 39' S, long 53° 42' W, alt 461 m asl). Due to the superior performance of UFSMFW 2-07 compared to commercial controls, the line was tested in trials of Value for Cultivation and Use (VCU) from 2018 to 2021, in Frederico Westphalen/RS. Owing to the outstanding performance, protection of the National Service for Cultivar Protection (SNPC) was requested, under the name cultivar UFSMFW 2202 (protection certificate no. 20210021).

Preliminary and VCU tests were carried out in a randomized complete block design with three replications. The plots consisted of six 5-m long rows spaced 0.17 m apart. Fertilization was applied as indicated by soil analysis and pests and diseases were controlled by the recommended management practices (Comissão 2014).

In the VCU tests, the following traits were evaluated: days from emergence to flowering - number of days from emergence until 50% of the panicles were completely outside the flag leaf; days from emergence to maturity; plant height - measured from plant base to apex, in cm; number of tillers per plant – count of the number of tillers of 10 plants per plot at maturity; dry matter per plant - weighing of dry matter of 10 plants per plot at maturity, in g; fresh matter – weighing of all plants in two sample areas of 0.25 m² per plot at flowering, expressed in kg ha^{-1}; dry matter yield - weighing of dried fresh matter samples, in kg ha^{-1}; grain yield – weighing after manual harvest of the plots, in kg ha^{-1}. The data were subjected to analysis of variance and the means grouped by the Scott and Knott test.

Table 1. Mean fresh matter, dry matter and grain yield of cv. UFSMFW 2202 and control cultivars in tests for the Value for Cultivation and Use (VCU), growing seasons 2018 to 2021

Cultivars	Fresh matter (kg ha^{-1})				
	2018	**2019**	**2020**	**2021**	**Mean**
UFSMFW 2202	49086.3 a	59266.7 a	35861.1 a	27301.0 a	42878.8 a
UPFA 21 - Moreninha	47895.6 a	58146.7 a	38143.7 a	23922.8 b	42027.2 a
IPR Cabocla	41075.3 b	41640.0 b	26237.7 b	21976.7 c	32732.4 a
Control mean	44485.5	49893.3	32190.7	22949.8	37379.8
Cultivars	Dry matter (kg ha^{-1})				
	2018	2019	2020	2021	**Mean**
UFSMFW 2202	7622.9 a	10466.7 a	7082.9 a	5968.5 a	7785.3 a
UPFA 21 - Moreninha	8000.7 a	10933.3 a	6746.1 b	5305.1 b	7746.3 a
IPR Cabocla	7125.9 a	7746.7 b	5606.4 c	4808.3 b	6321.8 b
Control mean	7563.3	9340.0	6176.3	5056.7	7034.1
Cultivars	Grain yield (kg ha^{-1})				
	2018	2019	2020	2021	**Mean**
UFSMFW 2202	3243.1 a	4152.1 a	2074.7 a	1923.7 a	2848.4 a
UPFA 21 - Moreninha	2498.6 b	2257.2 b	1371.0 b	1636.8 b	1940.9 b
IPR Cabocla	2108.8 b	2114.7 b	1337.5 b	1503.3 b	1766.1 b
Control mean	2303.7	2185.9	1354.2	1570.1	1853.5

Means followed by the same lowercase letter in a column do not differ significantly from each other by the Scott and Knott grouping test at 5% error probability.

With regard to fresh matter, cv. UFSMFW 2202 had an excellent performance in all experimental years. In 2021, the new cultivar produced more fresh matter than the control cultivars. In the other experimental years, the fresh matter yield exceeded that of the control cultivars but did not differ from UPFA 21 - Moreninha. In terms of dry matter yield, UFSMFW 2202 exceeded the mean of the control cultivars (mean of 7785.3 kg ha^{-1}). In addition, the new cultivar was statistically superior to the control cultivars in 2020 and 2021 (Table 1). According to Nascimento Junior et al. (2015), the dry matter yield averaged across 12 experimental trials of the cultivars BRS Centauro and UPFA 21 - Moreninha, respectively, was 6541.0 and 5837.0 kg ha^{-1}. These results indicate the high dry matter yield potential of cv. UFSMFW 2202.

For grain yield, cv. UFSMFW 2202 performed exceptionally well, exceeding the mean of the control cultivars in all test years, reaching 2848.4 kg ha^{-1} (Table 1). 'UFSMFW 2202' showed grain yield that is usually only achieved using white oat cultivars (Nava et al. 2016, Pacheco and Federizzi 2020). Moreover, average maturity was earlier than that of the control cultivars. In other words, when the main objective of cultivation is grain yield, cv. UFSMFW 2202 can produce more in less time (Table 2). Cultivar UFMFW 2202 had an earlier vegetative and reproductive cycle than the average of the control cultivars and performed particularly better than cv. UPFA 21 – Moreninha (Table 2).

The results are even more promising with regard to days from emergence to flowering (Table 2). Cultivar UFSMFW 2202 has an early, significantly shorter cycle than the control cultivars. In crop rotation systems, an early cycle is advantageous, for allowing anticipated sowing of the subsequent crop, and because the high-quality straw left on the

Table 2. Means of days from emergence to flowering, days from emergence to maturity, plant height, number of tillers per plant, and dry matter plant^{-1} in tests of the Value for Cultivation and Use (VCU) of cv. UFSMFW 2202 and control cultivars, in the growing seasons from 2018 to 2021

Cultivars	Days from emergence to flowering (days)				
	2018	2019	2020	2021	Mean
UFSMFW 2202	82.7 c	83.2 c	83.7 b	83.5 c	83.3 c
UPFA 21 - Moreninha	96.3 a	96.0 a	93.5 a	95.0 a	95.2 a
IPR Cabocla	88.3 b	87.0 b	86.3 b	90.0 b	87.9 b
Mean control cultivars	92.3	91.5	89.9	92.5	91.6

Cultivars	Days from emergence to maturity (days)				
	2018	2019	2020	2021	Mean
UFSMFW 2202	124.2 c	124.9 b	125.7 c	125.4 c	125.1 c
UPFA 21 - Moreninha	142.0 a	141.5 a	137.8 a	140.0 a	140.3 a
IPR Cabocla	132.9 b	130.9 a	129.9 b	135.4 b	132.3 b
Mean control cultivars	137.4	136.2	133.8	137.7	136.3

Cultivars	Plant height (cm)				
	2018	2019	2020	2021	Mean
UFSMFW 2202	151.1 a	149.0 a	149.2 a	111.8 a	140.3 a
UPFA 21 - Moreninha	145.2 a	151.5 a	140.6 b	112.0 a	137.3 a
IPR Cabocla	133.0 b	136.5 b	137.2 b	107.9 a	128.7 b
Mean control cultivars	139.1	144.0	138.9	109.9	133.0

Cultivars	Number of tillers per plant				
	2018	2019	2020	2021	Mean
UFSMFW 2202	3.3 a	3.2 a	1.9 a	2.3 a	2.7 a
UPFA 21 - Moreninha	2.8 a	2.2 b	1.9 a	2.3 a	2.3 a
IPR Cabocla	2.9 a	2.0 b	2.0 a	2.4 a	2.3 a
Mean control cultivars	2.9	2.1	1.9	2.4	2.3

Cultivars	Dry matter per plant (g)				
	2018	2019	2020	2021	Mean
UFSMFW 2202	4.4 a	5.5 a	3.8 a	3.1 a	4.2 a
UPFA 21 - Moreninha	3.1 b	3.6 b	3.1 b	2.8 a	3.2 b
IPR Cabocla	2.8 b	3.5 b	3.0 b	3.1 a	3.1 b
Mean control cultivars	3.0	3.5	3.1	3.0	3.1

Means followed by the same lowercase letter in a column do not differ significantly from each other by the Scott and Knott grouping test at 5% error probability.

soil is abundant and releases nutrients (Melo et al. 2011). In addition, cv. UFSMFM 2202 protects the soil against erosion and suppresses weeds (Carneiro et al. 2008).

The higher fresh and dry matter yield of cv. UFSMFW 2202 than of the mean of the control cultivars can be explained by the taller plant height, greater number of tillers per plant and higher dry matter per plant in certain years (Table 2).

Cultivar UFSMFM 2202 is very well suited as ground cover. Overall, the early cycle and high dry matter and grain yield potential are particularly promising. The cultivar was selected in Frederico Westphalen/RS and is consequently well-adapted to the region. Due to the high grain yield potential, seed producers can harvest higher grain yields per area within a shorter period. Cultivar registration by the National Registry of Cultivars (RNC) is underway, a partner for seed multiplication will be determined, and initially the north and northwest region of Rio Grande do Sul are indicated for cultivation.

OTHER RELEVANT TRAITS

With regard to the distinguishing traits that qualify a new cultivar for protection, in terms of days from emergence to flowering, cv. UFSMFW 2202 has a very early to early crop cycle in comparison with the medium-cycle cultivar UPFA 21 – Moreninha. The growth habit is intermediate, *versus* the semi-upright growth of the controls UPFA 21 - Moreninha, and IPR Cabocla. The frequency of plants with recurved flag leaf (blade) was medium compared to the low frequency of control cultivar. UPFA 21 - Moreninha.

SEED PRODUCTION

The black oat cultivar UFSMFW 2202 was protected by the Brazilian Ministry of Agriculture, Livestock and Food Supply (MAPA) on 19/08/2020 (no. 20210021). Cultivar registration by the National Registry of Cultivars (RNC) is in progress, mediated by the UFSM Agency for Innovation and Technology Transfer (AGITTEC), which formalizes the transfer of technologies developed at the Federal University of Santa Maria (UFSM) to society, stimulating innovation and cooperation between the public and private sectors. Thereafter, a partner for seed multiplication will be identified (seed availability 420 kg).

REFERENCES

Carneiro MAC, Cordeiro MAS, Assis PCR, Moraes ES, Pereira HS, Paulino HB and Souza ED (2008) Produção de fitomassa de diferentes espécies de cobertura e suas alterações na atividade microbiana de solo de cerrado. **Revista Bragantia 67**: 455-462.

Comissão Brasileira de Pesquisa de Aveia (2014) **Informações técnicas para a cultura da aveia.** Fundação ABC/Universidade de Passo Fundo, Passo Fundo, 136p.

Leite JGDB, Federizzi LC and Bergamaschi H (2012) Mudanças climáticas e seus possíveis impactos aos sistemas agrícolas no Sul do Brasil. **Revista Brasileira de Ciências Agrárias 7**: 337-343.

Melo AV, Galvão JCC, Braun H, Santos MM, Coimbra RR, Silva RR and Reis WF (2011) Extração de nutrientes e produção de biomassa de aveia-preta cultivada em solo submetido a dezoito anos de adubação orgânica e mineral. **Semina: Ciências Agrárias 32**: 411-420.

Pacheco MT and Federizzi LC (2020) URS MONARCA - a new hexaploid oat cultivar with excellent grain yield and wide adaptation. **Crop Breeding and Applied Biotechnology 20**: e306220213.

Nascimento Junior A, Bevilaqua GP, Linhares AG, Fontaneli RS, Santos HP, Eichelberger L, Só e Silva M and Tomm OG (2015) BRS Centauro - oat cultivar for ground cover and grazing. **Crop Breeding and Applied Biotechnology 15**: 117-119.

Nava IC, Pacheco MT and Federizzi1 LC (2016) RRS Altiva - a new oat cultivar with high agronomic performance. **Crop Breeding and Applied Biotechnology 16**: 254-260.