OAT GROWER MANUAL: TABLE OF CONTENTS

1. OAT HISTORY, NORTHERN GREAT PLAINS	2017 Update
2. CLIMATE CHANGE and PLANT BREEDING	2017 Update
3. VARIETY REGISTRATION IN CANADA	2017 Update
4. VARIETY SELECTION	2017 Update
5. FIELD SELECTION	2017 Update
	*
6. SEEDING	2017 Update
7. FERTILITY	2017 Update
8. SPECIAL AGRONOMY	2017 Update
9. WEED MANAGEMENT	2017 Update
10. DISEASE MANAGEMENT	2017 Update
11. INSECT MANAGEMENT	2017 Update
12. HARVEST MANAGEMENT	2017 Update
13. SPECIAL PRODUCTION	2017 Update
14. GRAIN STORAGE	2017 Update
15. FURTHER TOPICS	

1. OAT HISTORY, NORTHERN GREAT PLAINS

PLANT BREEDING – The impact

The quoted page from the book below puts into perspective, the value of the effort of crop improvement through breeding. The improvement continues to this day in oats for western Canada and is a permanent resource for prairie farms.

<u>THE CEREALS IN AMERICA</u>, by Thomas F. Hunt (Professor of Agronomy in Cornell University), 1904



"The importance of Plant Breeding. – The individual plant is the result of two forces: environment (climate, soil, fertilizer, culture, etc.) and heredity (parents, grandparents, etc.). The increased yield of a crop by modification of environment, although a necessary process to successful agriculture, can only be accomplished by an expense more or less considerable. Heredity, however, is a silent force, which acts without expense. If a plant be discovered that would produce because of the force of inheritance only one grain of maize more on each ear than at

present, it would be capable of increasing the maize crop of the United States five million bushels of maize, not next year alone but for years to come. This is the significance of improved seed.

[Luther Burbank:] 'The vast possibilities of plant breeding can hardly be estimated. It would not be difficult for one man to breed a new rye, wheat, barley, oats or rice which would produce one grain more to each head, or a corn which would produce and extra kernel to each ear, another potato in each plant, or an apple, plum, orange or nut to each



tree. What would be the result? In five staples only in the United States alone the inexhaustible forces of Nature would produce annually without effort and without cost:

> 5,200,000 extra bushels of corn, 15,000,000 extra bushels of wheat, 20,000,000 extra bushels of oats, 1,500,000 extra bushels of barley 21,000,000 extra bushels of potatoes.

But these vast possibilities are not alone for one year, or for our own time or race, but are beneficent legacies for every man, woman or child who shall ever inhabit the earth.""

WESTERN CANADA - 1920

Crop Production in Western Canada John Bracken, Professor of Field Husbandry, University of Saskatchewan The Grain Growers' Guide, Limited Winnipeg, Manitoba, Canada 1920

CHAPTER V

OATS

The Cereal of the Park Belt.

130. Oats in Western Canada.-In Western Canada oats is the queen of stock foods, surpassing all others in most parts in yield of grain and cheapness of fodder and excelling them in feeding value both as a concentrate and as roughage.

The chief uses of the oat crop are (1) a concentrate for horses and other stock, (2) a hay crop for all classes of stock, (3) an ensilage crop and (4) as human food.

Oats constitutes practically the only concentrate fed to horses in the West. It can be easily and cheaply grown and is well suited to the requirements of working animals. It is also the chief forage now used for all classes of stock in the grain growing areas, where it is sown usually on spring plowing after the wheat is seeded, and harvested with the binder when in the milk or early dough stage. It is now being satisfactorily used as a silage erop in the more moist districts that are not well suited to growing corn. For this purpose it is frequently sown in a mixture with peas. Oats are also used by a large percentage of the population as a breakfast food in the form of rolled oats. In this form 142

it provides more nourishment at lower cost than any other cereal.

OATS

Its relative importance is greatest in the park belt just north of the wheat regions, in the higher altitudes of the third prairie steppe and on some of the heavier types of soil in the wheat regions where wheat is subject to lodging or to fall frosts. It is grown more or less in all districts, but less in the eastern Chinook belt and in the more favored wheat regions than elsewhere.

In Manitoba oats occupy over one-third of the grain acreage, in Saskatchewan about one-quarter and in nearly one-half. Manitoba now produces Alberta



about one-seventh of the Canadian crop, Saskatchewan over a third and Alberta between one-quarter and onefifth, while British Columbia produces less than one per cent. of it. The three Prairie Provinces now produce about two-thirds of the total Canadian crop.

In this 1920 account of oat production in western Canada, it is clear that oats is a powerful component on the farm at this time in Canadian history. It is in fact the original biofuel driving agricultural productivity. Notice also the prioritized uses of oat of which food is at the bottom:

1. A concentrate for horses and other stock, "easily and cheaply grown..."

2. a hay crop for all classes of stock, "harvested with binder...early dough stage."

3. an ensilage crop and "in the more moist districts that are not well suited to growing corn."

4. as human food. "it provides more nourishment at lower cost than any other cereal."

"In Manitoba oats occupy over one-third of the grain acreage, in Saskatchewan about on-quarter and in Alberta nearly on-half."

2. CLIMATE CHANGE & PLANT BREEDING

The world is changing and the climate with it. As we look back over numerous crop years, the good and the bad, the wet and dry, we see changes. It is too difficult on a local level to predict the weather of an upcoming crop season, even if larger global trends are seen.

Below are some quotes from 2011 and 2012 that speak of doom and gloom in the future for crops unless urgent work toward adaptation takes place. In reality, the adaptation of our crop varieties is <u>Always</u> taking place. <u>Every</u> year in oat breeding for instance, a new 10 to 12 year breeding/development cycle begins again. All oat breeding early generation genetic material is subjected to the climate, good or bad,... <u>All</u> the time. If there are changes to the climate, noticeable to us or not, the plants that are part of the breeding program are responding and the best are being selected. The breeding process is an excellent tool for adaptation in all our crops. And yes, it is true that the weeds are adapting too.

The Western Producer – December 22nd, 2011 – Sean Pratt

"Chicago – Farmers can expect a continued trend toward wetter and warmer growing seasons and more weather volatility in the years ahead, according to two American weather experts.

"If you're going to be farming in the future, your experience with weather and climate are going to be different than anybody who has been farming the last 30 to 40 years," said Charlie Walthall, national program leader for climate change at the U.S. Department of Agriculture's Agricultural Research Service.

"Crops are not being bred to take advantage of the additional carbon dioxide in the air, but weeds are thriving under those conditions.."

Further...

The Manitoba Co-operator – January 5th, 2012 – Daryll E. Ray and Harwood D. Schaffer

"We have not bred the variety of crops to take advantage of higher carbon dioxide in the atmosphere," Walthall said.



"Cary Fowler, executive director of Global Crop

Diversity Trust says: 'I don't think that people have begun to grapple with the enormity of the problem (of climate change)...agricultural crop adaptation really isn't even on the agenda. All our efforts at the macro-level are clearly going to fail as the crops die in the field.'"

3. VARIETY REGISTRATION in WESTERN CANADA 2017 Update

In western Canada, the Prairie Recommending Committee for Oat and Barley (PRCOB) is responsible for coordinating the yearly testing and evaluation of barley and oat candidate cultivars. This effort is made for the purpose of developing variety recommendations to be passed on to the Variety Registration Office of the Canadian Food Inspection Agency.

START UP and PURPOSE

Excerpts from the:

PRAIRIE REGISTRATION RECOMMENDING COMMITTEE FOR GRAIN MINUTES OF THE FIFTH MEETING February 21-22, 1994, Calgary Alberta

The variety registration system originated with the 1923 amendment to the *Seeds Act* that required all agricultural and vegetable varieties to be tested for merit and licensed by the Minister of Agriculture. An amendment to the Act in 1937 exempted vegetables and herbs from the licensing requirement. A 1993 amendment to the *Seeds Regulations* exempted lawn, turf, reclamation and ground cover species as well as home garden potatoes from the registration requirement because of the highly subjective nature of determining merit in varieties of these crops.

The initial reason for establishing licensing was to permit only those varieties exhibiting merit to be sold in Canada. Since 1928, the Minister has had the authority to refuse to license a variety if it is found to possess inferior qualities that would impair its commercial value or fail to fit into the grain grading system. As a result of the 1992 regulatory review, it is clear that merit remains the overriding principle for retaining the variety registration system. The mandate of the system is:

- to ensure that new varieties meet current requirements for resistance to economically important diseases,
- to ensure high quality products for processors and for consumers and
- to ensure that agronomically inferior or unadapted varieties are excluded from the Canadian marketplace.

OAT DEVELOPMENT FLOW

Varieties of oats do not appear out of "thin air". The contributors to development of oats in western Canada, are Agriculture and Agri-food Canada, Provincial government initiatives, Universities, private industry and also individuals. These efforts date back to the beginnings of farming on the prairies. Influences and development initiatives these days come also from European, South American, American, Australian sources etc., which make contributions to the western Canadian oat scene.

Beginning with a desire to overcome some agronomy challenge, emerging changes in field production machinery or challenges within the ecosystem of the oat crop, oat



developers and breeders choose parental plants for combinations to meet the need.

From the initial hand pollination between oat plants of interest, 6 or 7 years or seasons pass by with selections being made to guide a group of plants in a genetic population toward entry into the Western Cooperative Oat Registration Trial (WCORT). Two years in the WCORT allow breeders, collaborators, competitors and interested industry

parties to have a look at the attributes of a concentrated set of promising oat lines. Three more years or so will follow as successful oat candidates are field increased to be ready for a certified seed release to oat growers.

For those first 6 to 7 years of the breeding process, adaptation to local climate and geography, and continuing influence climate change, fixes the characteristics of an oat variety. The best adapted move forward. A full cycle of variety development extends

beyond those initial years to approximately 10 to 12 years. This is a normal, expected, and productive cycle that needs, due to the amount of work involved, to take time.

Once reached the seeming completion is not yet met. Milling and agronomy evaluations will judge the finished breeding work before a variety comes into a wide appeal and industry acceptance.



4. VARIETY SELECTION

Oat varieties developed in an oat growing region will be well adapted to that region. Breeding stations at Lacombe, Saskatoon, Winnipeg, Brandon etc., across the western Canadian prairies, tend to produce successful varieties for their specific areas. AC Morgan from Lacombe for instance is a very successful oat variety with broad uptake in Alberta. Derby and CDC Dancer contribute excellent grain quality and were bred in Saskatchewan. Leggett is an oat variety with strong disease resistance and adaptation for Manitoba.



Still, extending from the locations of breeding, a good number of oat varieties do find appeal and value into new areas. The appeal of AC Morgan resulted in this oat variety being grown in a very wide area, far from its original breeding geography.

Generally, cultivated oats (*Avena sativa*) grow well in the dark brown to black to grey and dark grey areas of the prairies. They grow best with cool temperatures and are less drought tolerant than barley or wheat.

Choosing which varieties of oats to grow on the farm should be an informed choice with influence from important sources such as:

≻Oat Millers' recommended variety lists

≻Provincial variety guides

Saskatchewan: <u>https://www.saskseed.ca/images/seed_guide2017.pdf</u>

>Field days/producer meetings

► Local area fields and/or demonstrations

► Local seed growers

Seed industry representatives

MARKETS FOR OAT VARIETIES

1920 From the historical section earlier in this manual, the order of use and ``market`` for oats was heavily focused on feed.

- 1. A concentrate for horses and other stock,
- 2. a hay crop for all classes of stock,
- 3. an ensilage crop and
- 4. as human food.

"In Manitoba oats occupy over one-third of the grain acreage, in Saskatchewan about on-quarter and in Alberta nearly on-half."

With the percentage of the farm dedicated to oat production vastly smaller now compared to 1920, the priorities for the oat crop have shifted. As an example of acreage changes, acreage numbers from Saskatchewan are given in the chart below for the years between 1921 and 2004.

Table 2. Area of Major Crops Grown in Saskatchewan, 1921 to 2004, in thousand acres									
Year	Spring- wheat	Durum wheat	Oat	Barley	Rye	Flax	Canola	Special Crops	Tame hay
1921	13,557	—	5,682	498	1,208	427	—	—	288
1931	15,026	-	4,295	1,375	528	509	-	-	174
1941	12,120	75	4,026	1,659	527	725			430
1951	15,163	472	3,815	2,449	710	296	7	-	572
1961	14,504	1,578	1,492	1,839	239	941	374		1,052
1971	11,034	1,889	1,966	5,571	528	925	2,737	246	1,646
1981	15,850	3,450	1,100	3,700	500	350	1,350	327	1,700
1991	17,253	3,925	510	3,100	225	545	3,359	1,083	2,432
2001	10,550	4,150	1,300	4,250	105	1,165	4,650	6,125	3,050
2004	9,880	4,600	2,100	4,800	170	1,400	6,150	6,175	-
Source: Agriculture Statistics									

Today approximately one quarter to one third of oat production in western Canada is destined for human consumption.

There remains steady use oats for forage purposes, (cover crop mixes and grazing, hay, swath grazing, yellow feed, silage etc.) but a larger component of oat acres is destined for the grain market (horses, as a component in stock feeds, human consumption).

Regarding human consumption of oats, the quality and requirements needed from the oat grain have greatly increased over the past 100 years. When considering what variety of oats to grow and if a milling oat is your goal, consideration of oat millers' preferred oat variety lists is essential.

Oat millers employ a complex stream of machine operations to process the oat crop. A good mill yield, the resulting quantity and value of products exiting the mill in relation to the grain that came in, is essential to a miller's existence.

From a grain perspective, milling profitability is not only dependant on the seasonal quality of the oat crop but also on the milling characteristics of the oat varieties coming through the mill. So with new varieties coming through the Western Cooperative Oat Registration Trials (WCORT) each year or two, and then onto full registration and into seed growers hands, milling evaluation of new varieties has now become essential.

Look to Millers' preferred oat lists, available at grain terminals and milling locations, for guidance on the oat varieties that suit them, and that will grow well in your area.

ON FARM INVESTIGATION OF NEW OAT VARIETIES

How an oat variety performs will be influenced by the weather of the season of course, but the way it grows will probably be more reflective of the farming practices on the farm where it was grown.

Sources of information on varieties will not match comparisons that you can achieve on your farm by growing two oat or more oat varieties on the same field.

"Head to head" in field comparisons of oat varieties are a great way to introduce yourself to new oat varieties.



5. FIELD SELECTION

2017 Update

SOIL

Select fields with good drainage, sandy loam to heavy clay soil textures. Avoid fields that had cereal crops in the previous year to reduce disease pressure and optimize yields. As well, volunteer cereal grain in an oat sample may cause downgrading.

Oats yield the best in the black and grey wooded soil zones due to the higher moisture content of the soil (Saskatchewan Ministry of Agriculture 2009)

Avoid fields with a history of heavy wild oat pressure, and also avoid fields with a history of herbicide applications that may affect the growth of oats.

CROP ROTATION

➤GRAIN MILLERS – Oats, if possible, should not be rotated back to back with other cereal grains. Back to back rotation with other cereal grains increases the risk of plant disease and weed pressure. More desirable rotational crops include: canola, hayfields, soybeans, and/or other legumes. These crops give oats a strong potential by providing nutrients and reducing disease risk. Corn falls between the desirable rotational crops and the cereal grains. Corn can increase the risk of some plant diseases and tie up nitrogen early in the season.

A next chart, originating from the Canola Growers Association 2013, can help in the understanding and benefit of crop rotation. In the numbers here, canola grown on oat stubble (124%) has a better yield than canola on wheat (118%) or barley(119%). Flax looks like it does well too, on oat stubble.

Relative Yield of Major Crops Sown on Selected Stubble Types in Rotation in Manitoba during 1994-1998 (from Manitoba							
Crop insurance Corporation)	Stubble Type						
	Wheat	Barley	Oats	Brassica napus	Flax	Peas	
	Canola Relative % yield (crop on own stubble=100%)						
Wheat	100	109	110	118	114	120	
Barley	115	100	110	119	122	122	
Oats	114	103	100	124	123	115	
Brassica napus canola	114	115	117	100	118	128	
Flax	148	148	146	133	100	**	

** Insufficient Data

The benefits of oats in crop rotation - A U.S.A. Perspective

Oat Sustainability

namamillers.org /issues/sustainability/oat-sustainability/

Good for the Environment, Good for You

There are many and widely varying descriptions of sustainability. We see merit in the United Nations' definition, adopted as early as 1987, that defined sustainability simply as "meeting the needs of the present generation without compromising the ability of future generations to meet their needs."

Oats are an essential grain, both for human consumption and animal feed. Oat products are whole grain and heart healthy. Not only are oats healthy for consumers, oats are also healthy for the environment. Oats are especially valuable in environmentally sustainable crop rotation systems, helping to ensure sound cropping and soil conservation practices.

Most North American consumers don't know about the environmental benefits of growing oats. Oats are an ideal low-input crop which, when included in rotations, encourage crop diversity to reduce soil erosion and control plant diseases, insects and weeds. Oats crops do all this and more. In addition to the direct value of an oat crop – the grain and the straw – oats have value as a key component of agricultural systems that include several other crops in rotations.

Each crop has its particular diseases and insect pests.

Planting crops in a yearly rotation, such as oats/soybeans/wheat/corn, helps prevent buildup of many destructive organisms. Keeping disease organisms and insects at low levels reduces the risk of unexpected yield loss and the need for chemical pesticides. For example, a three-year rotation of corn/oats/soybeans nearly eliminates the problem of corn rootworm eggs hatching after extended dormancy in corn/soybean rotations and, thus, the need for corn rootworm insecticides.



6. SEEDING

2017 Update

SEED TREATMENTS

Seed treatments may be used to prevent seed and soil borne diseases, especially smut. The practice of seed treatment is a farm decision and is often key to a successful oat crop. Variety breeding strategies, and on farm production strategies are like a hand and a glove. They both are part of the success story on the farm.

It might be good for growers to know that oat breeding programs in general, never use seed treatments in the years of the oat breeding cycles. Number 1 it would be very difficult to treat the thousands of envelopes of seed used each spring, number 2 all envelopes are handled closely so personal safety would be a concern, number 3 and perhaps the most significant factor to variety development, is the reality that if the breeding program allows nature to take its course regarding soil and soil microorganism impact on the oat breeding seed populations, the strongest oat varieties emerge.

Soil borne diseases such as root-rots are likely to be larger problems in cool, wet growing conditions in the spring. Hulless oats are more susceptible to seed diseases and are recommended to be treated with a seed treatment.

2017 Alberta guide to crop protection:

- http://www1.agric.gov.ab.ca/\$Department/deptdocs.nsf/all/agdex32/\$FILE/606-1.pdf
- 2017 Saskatchewan guide to crop protection:
- http://www.publications.gov.sk.ca/details.cfm?p=77706
- 2017 Manitoba guide to crop protection
- https://www.gov.mb.ca/agriculture/crops/guides-and-publications/pubs/crop-protection-guide-full.pdf

SEED SIZE

The importance of seed size of the seeded oat crop has been a topic of conversation for many years. Growers have their own sense of the nature and amount of grain that they wish to seed per acre. It is might be easy to think that larger seed would be stronger and better but oat specific research on the matter has been said to be limited.

From the 2005 SEED SIZE research article on the following page:

"Our results clearly demonstrate the importance of initial caryopsis [grain] size to the outcome of wild oat-oat competition, and suggest that the ability of oat to exhibit both and increased competitive response and effect to wild oat competition may be a product of specific crop traits such as caryopsis [grain] size."

As the experiments on seed size were conducted in a greenhouse, the authors comment that:

"further investigation is needed to examine the response of oat-wild oat competition to oat caryopsis [grain] size and genotype under <u>field conditions</u>.

Definitions:

Caryopsis – also called grain, specialized type of dry, one seeded fruit characteristic of grasses and cereals

Genotype – the genetic makeup of an organism, the sum total of its genes, both dominant and recessive

DATE OF SEEDING

Early seeding can result in increased yield and test weight. It may also result in higher quality in areas that have frequent fall moisture. However, early seeding may also result in the oats emerging at the same time as or after wild oats emerge. This may result in reduced yields and lower quality due to wild oat contamination.

Optimum seeding dates will vary province to province. The growers own understanding of the current season that is being experienced, typical climate, the soil zone, long term experience etc., all work to guide the timing of seeding.

OAT GROWER MANUAL: ROW SPACING

Oats are usually seeded with a row spacing of 18-30 cm (7.5-12 inches). Research has indicated that there is very little differences in yields over a number of years within these row spacings. However, wider row spacings may result in an increased problem with wild oats and other weeds in oats.

As there is no chemical control for many grassy weed species, care must be taken using wider row spacing. In addition, wider row spacing may result in difficulty managing swaths in dry conditions as there may not be enough stubble to hold the swath off the ground.

RESEARCH PAPER (2005): Crop Science 45: 1410-1416 (2005)

"Oat Caryopsis Size and Genotype Effects on Wild Oat-Oat Competition"

AUTHORS:

Christian J. Willenborg¹, Brian G. Rossnagel², and Steven J. Shirtliffe^{3*}.

1 Dep. of Plant Sciences, Univ. of Saskatchewan

2 Crop Development Center, Univ. of Saskatchewan

3 Dep. of Plant Sciences, Univ. of Saskatchewan, *Corresponding author

INTRODUCTION:

"Wild oat competition causes extensive yield and quality losses in... oat"

"Traditionally, wild oat was controlled by delaying planting so that emerged wild oat could be controlled by tillage. However, delayed planting of oat causes substantial declines in grain yield, test weight, plump seed and groat percentage with a corresponding increase in thin seed percentage."

"A key component of integrated weed management systems is to grow competitive varieties."

"Our main objective was to assess the relative importance of oat caryopsis [grain] size and genotype in affecting wild oat-oat competition in the greenhouse....We conducted this study in a greenhouse because it provided us with a high degree of experimental control, repeatability, and precision, allowing us to isolate the effects of seed size on oat competitive ability."

SUMMARY:

This greenhouse study was conducted during 2002 and 2003 at the University of Saskatchewan at Saskatoon. AC Assiniboia, CDC Boyer and CDC Orrin were the varieties used. All seed was sourced from the same location. The seed groupings LARGE, MEDIUM and SMALL were determined on the basis of the groat size to eliminate the effects of the size of the hull.

RESULTS AND DISCUSSION:

"Oat derived from large caryopses [grain] produced 17% more biomass and 15% more panicles per m² than plants derived from small caryopses, irrespective of genotype or wild oat competition. Similarly, plants established from medium-seeded caryopses produced 11% more biomass and 9% more panicles than from plants established from small caryopses." *It was noted that statistically, the large and medium effects were not significantly different from each other.*

RESEARCH PAPER (2004): Canadian Journal of Plant Science (2004) 84: 431-442

"Early seeding dates improve oat yield and quality in the eastern prairies"

AUTHORS:

William E. May¹, Ramona M. Mohr², Guy P. Lafond¹, Adrian M. Johnston³, and F. Craig Stevenson⁴.

1 Agriculture and Agri-Food Canada, Indian Head Research Farm

2 Agriculture and Agri-Food Canada, Brandon Research Centre

3 Potash & Phosphate Institute of Canada

4 Private Consultant

INTRODUCTION:

"Traditionally, oat (*Avena sativa* L.) was the last crop seeded on farms in western Canada. Oat could be planted last and still be harvested or used as fodder depending on needs. The late seeding allowed farmers the opportunity to control wild oat (*Avena fatua* L.) in tame oat with tillage prior to planting. The harvested oat tended to be consumed locally with little attention paid to quality."

"There have been many changes in cropping practices on the prairies since the early studies in western Canada, the most significant being the introduction of one-pass seeding and fertilizing conservation tillage systems. These new production systems increase the amount of winter precipitation that is captured by the soil, resulting in higher yield and economic return. This increase in available water may increase the yield and quality of oat since oat requires more water than the other cereals."

SUMMARY:

In this study, conducted during 1998 to 2000, 3 locations were used: Brandon, Indian Head, and Melfort. AC Medallion, AC Juniper, CDC Boyer, and CDC Pacer were the varieties tested. Four seeding dates were chosen: early May, mid May, early June and mid June, and the target dates of these were May 01, May 15, June 01 and June 15.

RESULTS AND DISCUSSION:

> Delayed seeding decreased the yield of all four varieties.

>Disease resistance matters as it maintains plant health and the ability to continue using moisture for growth, while susceptible varieties suffer a decline during mid summer dampness.

 \geq "Two [related (1968 & 1990)] studies found that higher temperatures during development reduced seed yield."

≻ "Delayed seeding increased thin seed percentage at most locations;"

≻ "Results from this study clearly show that oat producers can grow more high-quality oat if seeding is conducted in the first 2 weeks of May."

SEEDING RATE

A plant population of 20-30 plants/ft² is desired. Seeding rates can be calculated using Thousand Kernel Weight.

Situations that require seeding rates at the higher end of the range stated above would include:

- High fertility
- Optimum moisture
- Late seeding (to reduce tillers)
- High wild oat populations anticipated

Additional on information SEEDING RATE from the research paper discussed above.

"Early seeding dates improve oat yield and quality in the eastern prairies"

RESEARCH PAPER (2004): Canadian Journal of Plant Science (2004) 84: 431-442

EXTRA NOTES:

During the course of the experiment in this research paper a 5% field mortality was used to adjust the target plant population to 300 plants per square metre (~28 plants per square foot) of viable seeds (including adjustment for germination).

"However, field mortality for the experiment ranged from 18 to 33% Our results indicate that oat seeding rate recommendations should factor a field mortality rate of 20 to 30% in order to achieve a target plant population."

OAT GROWER MANUAL: DEPTH OF SEEDING

Seed depth should only be deep enough to reach soil moisture and never deeper than 8 cm (3"). In direct seeding and where seedbed moisture is optimum, seed depth should be targeted towards 2-3 cm.

7. FERTILITY

FERTILIZER REQUIREMENT OF CEREALS

The total amount of plant nutrients removed from the soil by a crop depends on the yield – the greater the yield, the greater the amount removed.

Based on equal seed yields per unit area, whole barley, wheat and oat plants extract about the same combined quantities of nitrogen (N), phosphorus (P_2O_5), potassium (K₂O), and sulphur (S) from the soil, but considerably less than canola. When only the seed is removed, and all straw is left on the field, oats removes the least nutrients from the soil (except for sulphur) than barley, wheat or canola as the following table shows.

Сгор	Crop Part	N	P205	K20	S		
Wheat	Seed	79	32	21	5		
(3225 kg/ha or 48 bu/ac)	Straw	32	7	64	8		
	Total	111	39	85	13		
Barley	Seed	65	24	22	5		
(3225 kg/ha or 60 bu/ac)	Straw	34	9	73	8		
	Total	99	33	95	13		
Oats	Seed	58	24	17	8		
(3225 kg/ha or 84 bu/ac)	Straw	40	15	70	10		
	Total	98	39	87	18		
Canola	Seed	120	57	29	21		
(3225 kg/ha or 57 bu/ac)	Straw	70	26	121	17		
	Total	190	83	150	38		
(To convert kg/ha into lb/ac, multiply by 0.89) Canola yield is extremely high, but in order to make the comparison, it was left at the same weight as the other grains.							

Nutrients Used by Crops* (kilogram per hectare)

*Source: Western Canada Fertilizer Association. Last Reviewed/Revised on January 20, 2015.

NITROGEN (N)

In most fields in western Canada, nitrogen is the most yield limiting nutrient. Nitrogen is an essential component of amino acids and therefore, of proteins which include nucleic acids, enzymes and chlorophyll. Deficient crops will grow poorly and produce low yields of low quality.

Nitrogen requirements are closely tied to moisture. The more moisture that is received, the higher the yield potential and the higher the requirement is for nitrogen to achieve that yield. A 3584 kg/ha (100 bushel/acre) crop of oats will require 110-131 kg/ha (97-117 lbs/acre).

Work done by Ramona Mohr and Cynthia Grant, AAFC Brandon, and William May, AAFC Indian Head, confirmed these values, concluding that optimum yields were achieved when soil + fertilizer N level were approximately 100 kg N ha (89 lbs/acre). Optimum yields were usually achieved at 40-80 kg/ha (36-71 lbs/acre) applied N.

Rates above optimum levels caused yield decreases and crop lodging. Increasing Nitrogen rates also resulted in statistically significant declines in test weight, kernel weight and the percentage of plump kernels, all detrimental crop quality measurements.

Nitrogen for organic production can be added to the soil by producing crops that are able to "fix" their own nitrogen (legume crops such as alfalfa, clovers or pulses) and working the crop residue into the soil (plow-down). Livestock manure is also a good source of nitrogen.

PHOSPATE (P2O5)

Phosphate is involved in the formation of all oils, sugars, starches, etc. It helps with the transformation of solar energy into chemical energy, proper plant maturation and withstanding of stress. It also effects rapid growth and root development. Response to phosphate in oats is inconsistent and often does not respond to soil test levels. Situations that may respond to phosphate fertilizers include:

- > Fields that have not received phosphate fertilizers in past 5 years
- > Fields newly broken or broken from legume forage production
- > Crops grown on fallow
- Cold, wet soils
- Sandy or gravelly soils

Normally, an application of 20-30 kg/ha (18-28 lbs/acre) with half this amount applied with the seed, is usually adequate to produce optimum yields.

Phosphate for organic production can be added to the soil by applying rock phosphate. However, rock phosphate has a very low solubility so is very slowly available. Therefore, it should be used as a part of a long term program. This may also include using buckwheat as a plow-down crop. Buckwheat has been shown to have the ability to accumulate phosphate and make it available following a plow-down. Livestock manure is also a very good source of phosphate.

POTASSIUM (K2O)

Potassium helps in the building of protein, photosynthesis, grain quality and reduction of diseases. It also may increase straw strength. Oat response to potassium usually occurs when soil test levels are below 250 kg/ha (280 lbs/acre). Potassium deficient soils tend to be light textured (sand to sandy-loam), alkaline, carbonated and imperfectly to poorly drained in their natural state. Organic soils are also frequently deficient in potassium.

An application of 17 kg/ha (15 lbs/acre) seedrow applied potassium chloride (0-0-60) may offer benefits in cold, wet soils – even when soil test levels are sufficient, may result in a crop response. Applications made at levels higher that 20 kg/ha (18 lbs/acre) should be side-banded or broadcasted to avoid damage to seedling plants.

Potassium for organic production can be added from a number of sources including some sources of potassium sulphate. This will also add sulphur to the soil. Other sources include wood ash and greensand (glauconite). Livestock manure is also a very good source of potassium.

SULPHUR (S)

Sulphur is essential for production of protein and oil. It promotes activity and development of enzymes and vitamins as well as helping in chlorophyll formation. Oats require sulphur in a fairly high level in comparison to other crops. It is required at lower levels that canola but about the same per acre levels as wheat. Deficiencies appear similar to nitrogen deficiencies as pale, stunted plants. Often sulphur deficiencies appear as isolated spots in a field due to extreme variability across a field. This may also result in misleading results from soil tests if a high-sulphate area is inadvertently sampled.

An application of 10-18 kg/ha (9–15 lbs/acre) of a sulphate fertilizer will be sufficient in most soils, especially if a part of a well balanced sulphur program. Applications of elemental sulphur may not provide adequate levels of sulphur, especially if applied in the seed-row.

Sulphur for organic production can be added from a number of sources including some sources of potassium sulphate. This will also add potassium to the soil. Other sources include gypsum (calcium sulphate)and some sources of elemental sulphur. Livestock manure may be a good source of sulphur.

MICRONUTRIENTS

There are a number of nutrients classified as micro-nutrients that are essential to plant growth. Where deficient, these may cause a reduction in crop production. Normally, these will not be deficient in western Canadian soils.

Of these, oats is most susceptible to a deficiency of Manganese. Manganese deficiencies mainly occur on organic soils, high-pH soils or sandy soils low in organic matter. A manganese deficiency in oats results in a disorder known as Grey Speck.

Oats show manganese deficiency as a general yellowing and stunting, occasionally with grey specks on the leaves. A foliar application of manganese will cure a manganese deficiency where it occurs.

SOIL TESTING

Soil testing should be used for determining fertilizer applications on specific fields. Where soil tests are not available, general recommendations may be followed. However, field history, cultural practices and inherent fertility of the field must be considered when using general recommendations.



RESEARCH PAPER (2004): Canadian Journal of Plant Science (2004) 84: 1025-1036

"Effect of nitrogen, seeding date and cultivar on oat quality and yield in the eastern Canadian prairies"

AUTHORS:

William E. May¹, Ramona M. Mohr², Guy P. Lafond¹, Adrian M. Johnston³, and F. Craig Stevenson⁴.

1 Agriculture and Agri-Food Canada, Indian Head Research Farm 2 Agriculture and Agri-Food Canada, Brandon Research Centre 3 Potash & Phosphate Institute of Canada 4 Private Consultant

INTRODUCTION:

As the portion of the oat crop increases for the human consumption segment, yield and quality, especially test weight, are important production parameters for a profitable oat crop. "The grower has to strike a balance between test weight and yield when optimizing N rate because the value of the oat is a function of both grain yield and quality."

SUMMARY:

In this study, conducted during 1998 to 2000, 4 locations were used: one in Manitoba and three in Saskatchewan. The locations were: Brandon, Indian Head, Canora and Melfort. Three seeding dates were used, early May, Mid May and early June, along with the two cultivars AC Assiniboia and CDC Pacer. The four nitrogen rates used were 15, 40, 80 and 120 kg N/ha.

RESULTS AND DISCUSSION:

Panicles per plant was the yield component that accounted for most of the yield increase achieved from increasing rates of nitrogen. Kernel weight was the yield component that decreased with increasing N. Physical seed quality tended to be highest with early seeding and low N rates.

The optimum N rate was found to involve a trade off between yield and quality.

Results from this study clearly show that to increase the probability of producers growing a profitable oat crop in the eastern Canadian prairies, seeding should occur by the middle of May with the N rate of between 40 and 80 kg/ha (~35 and 70 lbs/ac) when the residual nitrate levels in the soil range between 20 and 50 kg/ha (~18 and 44 lbs/ac). If seeding is delayed, then only 40 kg/ha N should be used to maintain oat quality

8. SPECIAL AGRONOMY

Plant breeding for oat improvement has resulted in today's successful oat varieties which have economic importance on the farm.

From the pressures of farm mechanization, oat varieties stand with more strength and yield more than oats in decades past. The resulting high quality grain that is delivered passes on economic success from the farm to the end users.

The changing realities of climate, farm systems, oat milling operations and consumer wants and needs keeps up the pressure to improve the oat crop. Routinely, one hears of oats yielding 150 toward 200 bushels per acre in the best oat growing situations. The standard 34lb/bu oat is a target long left behind as physical grain quality continues to rise. The intrinsic nutrition of oats has also, through traditional plant breeding acting on available variation, gained ground with the accumulation of desirable health factors in the grain.

Along with the oat breeding "upgrades', oat agronomy has become a key partner in this success of oats and continues to build momentum for outstanding results. Now, instead of the crop last thought of, keen oat growers are putting new products and techniques to the test with the goal of superior oat production. Many products developed for higher valued crops are being tried on oats such as:

- Cereal innoculants
- > Slow release and inhibited nitrogen fertilizer
- > Plant growth regulators for shortening stems
- Foliar applied crop nutrition
- Foliar applied biostimulants

Variety specific agronomy has enter the arena of crop production around the world and it is a welcomed direction The future of oat production will excel with these modern initiatives.

9. WEED MANAGEMENT

BROADLEAF WEEDS

Broadleaf management strategies that should be considered include increasing seeding rates, using weed control (tillage or herbicide) prior to seeding and varying seeding dates. There are also a number of herbicides available for weed control in oats.

Herbicides containing 2,4-D should be avoided on oats as it has been shown to cause considerable yield reduction. Products containing dicamba should be used according to the stage restrictions on the label. Application of dicamba products under stress conditions should be avoided.

GRASSY WEEDS

Grassy weed management strategies are much more difficult in an oat crop. Growers should be considering increasing seeding rates, using weed control (tillage or herbicide) prior to seeding and varying seeding dates. There are a limited number of herbicides registered to control grassy weeds. Lorox/linuron are registered for controlling barnyard grass and suppression of green foxtail.

There are a number of strategies used to deal with wild oats. They include:

- Growing on fields with low wild oat populations.
- Delaying seeding until wild oats have emerged and are controlled.
- Using tillage or herbicides just before emergence of the oats to control emerged wild oats.
- Increasing the oat seeding rate in order to have a more competitive crop.
- Applying fertilizer in precision bands adjacent to the seedrow in order to make the crop as competitive as possible.
- Using delayed release seed placed N to keep nutrients for later crop stages.
- Growing most competitive variety of oats.
- Consider seeding oats with a larger seed size. [See research article below]
- In rotational crops before and after an oat crop, wild oat populations can be depleted with the use of herbicides or growing a perennial forage crop for a number of years.

2017 Alberta guide to crop protection:

http://www1.agric.gov.ab.ca/\$Department/deptdocs.nsf/all/agdex32/\$FILE/606-1.pdf

2017 Saskatchewan guide to crop protection:

الله: <u>http://www.publications.gov.sk.ca/details.cfm?p=77706</u>

2017 Manitoba guide to crop protection

https://www.gov.mb.ca/agriculture/crops/guides-and-publications/pubs/crop-protection-guide-full.pdf

2017 Update

RESEARCH PAPER (2005): Crop Science 45: 1410-1416 (2005)

"Oat Caryopsis Size and Genotype Effects on Wild Oat-Oat Competition"

AUTHORS:

Christian J. Willenborg¹, Brian G. Rossnagel², and Steven J. Shirtliffe^{3*}.

1 Dep. of Plant Sciences, Univ. of Saskatchewan

2 Crop Development Center, Univ. of Saskatchewan

3 Dep. of Plant Sciences, Univ. of Saskatchewan, *Corresponding author

INTRODUCTION:

"Wild oat competition causes extensive yield and quality losses in... oat"

"Traditionally, wild oat was controlled by delaying planting so that emerged wild oat could be controlled by tillage. However, delayed planting of oat causes substantial declines in grain yield, test weight, plump seed and groat percentage with a corresponding increase in thin seed percentage."

"A key component of integrated weed management systems is to grow competitive varieties."

"Our main objective was to assess the relative importance of oat caryopsis [grain] size and genotype in affecting wild oat-oat competition in the greenhouse....We conducted this study in a greenhouse because it provided us with a high degree of experimental control, repeatability, and precision, allowing us to isolate the effects of seed size on oat competitive ability."

SUMMARY:

This greenhouse study was conducted during 2002 and 2003 at the University of Saskatchewan at Saskatoon. AC Assiniboia, CDC Boyer and CDC Orrin were the varieties used. All seed was sourced from the same location. The seed groupings LARGE, MEDIUM and SMALL were determined on the basis of the groat size to eliminate the effects of the size of the hull.

RESULTS AND DISCUSSION:

"Oat derived from large caryopses [grain] produced 17% more biomass and 15% more panicles per m² than plants derived from small caryopses, irrespective of genotype or wild oat competition. Similarly, plants established from medium-seeded caryopses produced 11% more biomass and 9% more panicles than from plants established from small caryopses." *It was noted that statistically, the large and medium effects were not significantly different from each other.*

10. DISEASE MANAGEMENT

There are four diseases of oat that typically affect the crop each season. The two major ones, Stem Rust and Crown Rust, sweep into Manitoba and eastern Saskatchewan each year to the degree in which the weather is favourable.

Moisture and temperature are the drivers of disease and once established in a field, the pathogen will spread from plant to plant. Breeding for resistance to these diseases is time consuming and costly. Furthermore sources of new plant resistance, that is the means by which the oat plants defend themselves, are more difficult to find and implement now. In any crop, there isn't an endless source of resistance genes waiting to be used. The crown rust fungus for instance continues to evolve and develop new races that are able to overcome genetic resistance. Therefore, resistant varieties become susceptible to crown rust as new races develop.

CROWN RUST (Puccinia coronata)

Crown rust, sometime called "Leaf Rust", generally is the most widespread and destructive disease of oats in western Canada. Crown rust can reduce yields, lower test weights and groat percentage, and increase lodging through a weakening of the stem.

Crown rust is identified by the pustules on the leaf producing yellow-orange spores that infect leaves primarily. As the crop approaches maturity, a black spore stage (Teliospores or "resting spores") may also be found on the oat leaves, appearing as a black or dark brown ring around the yelloworange pustules.





These black spores are the overwintering stage, although in western Canada they generally don't survive the cold. The name "Crown Rust" comes from the microscopic look of those Teliospores which have a crown like structure on their surface.

Each spring in Canada, spores of this fungal disease and Stem Rust as well are blown in from winter, oatproducing regions in the southern United States.



Seeding early will allow the crop to develop past the most susceptible stage in the areas where the risk of Crown Rust is greater. The Red River Valley is the first area to receive the spores from the south, as shown in the image here, and the Crown Rust infections will gradually spread to the western Prairie depending on the weather.

"Ideal conditions for oat crown rust are mild to warm daytime temperatures, so sunny days at about 20 C to 25 C, and moderate nighttime temperatures around 15 C to 20 C, along with good dews and adequate moisture." – Albert Tenuta, plant pathologist, Ontario Ministry of Agriculture, Food and Rural Affairs.

Growing varieties with disease resistance is an effective and economical method of controlling Crown Rust. Refer to the latest oat variety selection guide to select varieties resistant to prevalent races of Crown Rust.

STEM RUST (*Puccinia graminis f. sp. avenae*)

Stem rust epidemics are infrequent on the Canadian prairies, but they have the potential of being serious in southern Manitoba if oats are planted late and winds occur that blow spores in from the south. Spores of the fungal pathogen Stem Rust, like those of Crown Rust, drift northward seasonally from the U.S. in a weather dependent manner.

Stem rust and crown rust are distinguished fairly easily on the basis of spore color.

Stem Rust spores are more red in colour, while Crown Rust spores are a yelloworange. The coloured and dusty pustules erupt on the plants and release hundreds of thousands of spores to the air which may infect neighbouring plants and produce new pustules in 7 to 10 days. These colourful mid-summer spore types are replaced in August with a mass of black overwintering teliospores. As mentioned earlier, winter temperatures in western Canada are too cold generally for the spores to survive.



Control of stem rust, as with crown rust, can be economically accomplished by using resistant varieties. Refer to the latest selection guide to determine the level of resistance in available varieties to the prevalent races of stem rust. Stem rust resistance in oat varieties is generally more stable than crown rust resistance. Stem Rust resistance at first however, is more difficult to breed into the oat crop.

Also refer to the most recent edition of provincial Crop Protection Guide for details of the registered disease control products with which Stem Rust can be controlled.

BARLEY YELLOW DWARF VIRUS

Barley yellow dwarf (BYDV) is a virus that can cause significant yield loss in oats in western Canada. As the name implies, the barley yellow dwarf virus also infects barley



as well as wheat. It is transmitted from plant to plant by several species of grain aphids. These aphids usually acquire the virus when feeding on infected plants in the southern half of the U.S. and then are carried to northern oat fields in winds and by storm fronts. The disease potential greatly depends on the northward movement of these aphids from southern fields.

Barley yellow dwarfinfected plants normally are first seen along edges of fields. The leaves turn a yellow red to reddish brown. The entire leaf

blade may die prematurely. The plants generally are stunted and heads of infected plants often are severely blasted and seed is low in test weight. Oat varieties have some tolerance but there are no resistant varieties. Early planting can be helpful in reducing damage caused by BYDV.



LOOSESMUT (Ustilago avenae) & **COVERED SMUT** (Ustilago kolleri)

Smuts of oats have not been serious problems in western Canada. As with loose smut of barley, this disease can be controlled with seed treatment.

Most oat varieties are resistant to smut and provide good control of this fungal disease.

Consult crop protection guide for details of the registered seed treatments if desired.

FUNGAL LEAF SPOTS



Leaf spots on oats can be caused by a fungal pathogen known as Septoria avenae blotch. The disease is prevalent in eastern Canada but is of minor importance in western Canada. A crop rotation which puts two years or so between oat crops will help in the reduction of disease organisms for carryover. A number of fungicides are registered for the control of leaf spots. Refer to the most recent edition of provincial Crop Protection Guide for details of the registered products.

BLAST

Blast of oats occurs when the florets do not develop completely and sterility results. Florets are the developing flower structure on an oat panicle which typically forms two seeds. When Blast is observed, the florets are seen as white, skinny and empty.

Frequently, blast is due to high temperatures and moisture stress occurring at the time of panicle differentiation. As Blast is a stress related condition in oats, diseases may contribute to the problem.

Early planting reduces the likelihood of blast while late seeding and high seeding rates may favour the occurrence of blast.





FUSARIUM

Fusarium Head Blight is a fungal disease that is known to affect oats as well as other cereals (Bailey et al., 2003). The causal agent can be one or a complex of several *Fusarium* species, with *Fusarium graminearum* being the most common. Yield losses may be in the form of poor seed fill, floret sterility or impaired seed germination (Bailey et al. 2003). Fusarium head blight (FHB) is difficult to detect in standing oat crops. The major problem is the presence of mycotoxins on harvested seeds (Tekauz et al., 2004).

Deoxynivalenol or DON is the most common mycotoxin and is a risk to human and animal health, and can result in a lower grading. FHB is of highest concern in Manitoba and Saskatchewan with limited economic importance in Alberta (Tekauz et al. 2008). This disease is most common in the black soil zone, associated with high rainfall. The spread of disease is assisted by rainfall during crop flowering but can also occur via wind and planting of infected seed (Canadian Grain Commission, 2010).

CROP PROTECTION against PLANT DISEASES

The decision to grow a disease resistant variety is a tool for a successful growing season on the farm. Fungicides are also an important tool for the protection of a significant investment during the crop production season. May growers choose to apply a fungicide even on a variety that shows good disease resistance. The two can work together for success, and starting with a disease resistant variety is like a back up plan. Should the weather be such that getting to the field to spray a fungicide is not possible, the oat crop with disease resistance, through the breeding that went into it, will provide a good safeguard to your investment.

A number of fungicides are registered for use on oats. Many growers consider applying fungicide when the yield potential and value of the crop is high, when leaf diseases in the area develop early in the season and also if the long-range weather forecast is for continued moist weather. Refer to the most recent edition of provincial Crop Protection Guide for details of the registered products.

2017 Alberta guide to crop protection:

- http://www1.agric.gov.ab.ca/\$Department/deptdocs.nsf/all/agdex32/\$FILE/606-1.pdf
- 2017 Saskatchewan guide to crop protection:
- الله: <u>http://www.publications.gov.sk.ca/details.cfm?p=77706</u>
- 2017 Manitoba guide to crop protection
- https://www.gov.mb.ca/agriculture/crops/guides-and-publications/pubs/crop-protection-guide-full.pdf

[Please see the research summary below for an additional look into the value of using fungicides.]

RESEARCH PAPER (2014): Canadian Journal of Plant Science (2014) 94: 911-922

"Are fungicide applications to control crown rust of oat beneficial?"

AUTHORS:

W.E. May¹, N. Ames², R.B. Irvine³, H.R. Kutcher⁴, G.P. Lafond^{1†}, and S.J. Shirtliffe⁵.

1 Agriculture and Agri-Food Canada, Indian Head Research Farm

- 2 Agriculture and Agri-Food Canada, Richardson Centre for Functional Foods and Nutraceuticals
- 3 Agriculture and Agri-Food Canada, Brandon Research Centre

4 Agriculture and Agri-Food Canada, Melfort

5 Department of Plant Sciences, University of Saskatchewan

^{1†}Deceased

INTRODUCTION:

Crown rust causes significant damage to the Canadian oat crop and the organism continues to evolve. Plant breeding efforts continue in their efforts to try to defend the crop against the disease. "Currently, prophylactic fungicide applications are recommended to oat growers by industry agronomists, even in the absence of symptoms. Our objectives were to determine the influence of seeding date, cultivar and fungicide application on oat yield and quality in Saskatchewan and Manitoba."

SUMMARY:

In this study, conducted during 2009 to 2011, 6 locations were used: two in Manitoba and four in Saskatchewan. The locations were: Portage la Prairie, Brandon, Indian Head, Canora, Melfort, and Saskatoon.

AC Morgan, CDC Orrin, CDC Boyer, and Leggett were the varieties of examination. With respect to crown rust resistance they are categorized as very susceptible, susceptible, partially resistant and resistant respectively.

One fungicide was used in the study, the pyraclostrobin compound Headline[®].

"These results indicate that prophylactic fungicide applications are unlikely to provide yield improvement when early planting is combined with even a moderately disease-resistant cultivar."

"The only cultivar that consistently benefited from fungicide application was AC Morgan. Seeding in mid-May with even a moderately crown rust susceptible cultivar eliminated any benefit from fungicide application. In conclusion, it is recommended that growers seed early with a crown-rust resistant cultivar to avoid the need to apply a fungicide on their oat crops."

11. INSECT MANAGEMENT

2017 Update

INSECTS

Oats are not targeted by a great number of insects.

Insects such as cutworms, wireworms and grasshoppers can all cause damage to oats. Aphids may also affect oats but as a vector for Barley Yellow Dwarf Virus more than any actual impact on yield or quality. Refer to the most recent edition of your provincial for details of the registered products for specific insect control.

2017 Alberta guide to crop protection:

http://www1.agric.gov.ab.ca/\$Department/deptdocs.nsf/all/agdex32/\$FILE/606-1.pdf

- 2017 Saskatchewan guide to crop protection:
- memory http://www.publications.gov.sk.ca/details.cfm?p=77706 أله المعالية المعالي
- 2017 Manitoba guide to crop protection

me https://www.gov.mb.ca/agriculture/crops/guides-and-publications/pubs/crop-protection-guide-full.pdf

12. HARVEST MANAGEMENT

SWATHING

The architecture of the oat panicle* is such that oat kernel are in a more fragile situation at maturity compared with wheat and barley etc. Wind will rattle the top of the oat crop and while some oats may hold on longer than others, branches will break and seeds will fall.

In order to avoid losses from this shattering of the panicle, oats are often swathed, and then threshed by a combine with a pickup attachment. This method of harvest will also result in the ending of further growth and then bringing the crop to an even maturity in fields where ripening is variable.

Swathing of oats should start when the kernel moisture content is about 35%. At moisture levels above 35% yield, groat yield and test weight can be negatively affected. Oats are usually ready to swath when the panicle has turned yellow or brown, even as some stems still may show some green color and the least mature kernels have changed from green to cream.

* "Panicle: a loose, branching cluster of flowers, as in oats"

RESEARCH PAPER (2005): Canadian Journal of Plant Science (2005) 85: 839-846

"Oat quality and yield as affected by kernel moisture at swathing"

AUTHORS:

William E. May¹, Ramona M. Mohr², Guy P. Lafond¹, and F. Craig Stevenson³.

1 Agriculture and Agri-Food Canada, Indian Head Research Farm 2 Agriculture and Agri-Food Canada, Brandon Research Centre 3 Private Consultant

INTRODUCTION:

"Oat grown in western Canada is typically swathed and then combined. If the oat crop is swathed too early, seed yield and quality decline; however, if swathing is delayed, harvest losses increase."

SUMMARY:

In this study, conducted during 1997 to 2000, 2 locations were used: one in Manitoba and one in Saskatchewan. The locations were: Brandon and Indian Head.

Calibre and AC Assiniboia were the varieties of examination, and the oat crop was swathed at 5 levels of seed moisture content: 50, 41, 32, 23 and 14%.

RESULTS AND DISCUSSION:

"There was an increase in yield as swathing was delayed with most of the yield increase occurring between a kernel moisture of 50 and 41%. Therefore, a kernel moisture content of 41% or less resulted in highest yields."

"Kernel weight, plump seed and groat yield were optimized when kernel moisture was between 36 and 30% moisture content.

"After 30% kernel moisture was reached, no improvement in oat yield and quality occurred when swathing was delayed any further."

DESSICATION/PRE-HARVEST GLYPHOSATE

Caution should be applied when considering the application of glyphosate shortly before the harvest of your oat crop.

While being a popular management tool for oat production, weed control and the harvest operation, some concerns have been raised regarding effects on the integrity of the oat groat.

Further research is being conducted in western Canada to look into this topic. It is clear however, even noting the guidelines on the timing of a glyphosate application, that the use of the product requires information and care.

The acceptance of oat grain may be declined if the crop was sprayed with glyphosate.

Seed from fields that have been treated with a pre-harvest application of glyphosate should not be saved for seed.

COMBINING

The swathed oats should be threshed as soon as they reach an appropriate moisture. Straight cutting should not commence until all the oats have ripened as discounts will be made to seeds with green hulls. An alternative is to cut around the less ripe areas in a field and harvest these areas at a later date. Oats that are left too long in the field can weather and result in lower quality. If oats have been left to straight cut, weather may cause the stems to break down resulting in yield loss. As well, ripe oats are highly susceptible to shattering in heavy rain storms or wind.



Combine cylinder or rotor speed and concave clearances should be adjusted to produce a sample that does not contain de-hulled oats as these may result in the sample being down-graded. Hull-less oats are highly vulnerable to cracking and damage. Care must be taken to properly set the combine to avoid damage. This may require a further reduction in cylinder or rotor speed.

Oat buyers discount grain with high amounts of de-hulled kernels at delivery. Aim for much less than 5% dehulled oats through the harvest, storage/handling and delivery.

13. SPECIAL PRODUCTION

FEED AND FORAGE

Oats make an excellent feed for livestock. They have been used by cattle producers for years as a highly reliable feed source.

Cutting oats for feed when they are still green is referred to as green-feed. Oats are usually cut at the early to late milk stage for the best quality. The forage is then baled when the swath dries to or below 15% moisture. Oats can also be treated with glyphosate at the late milk stage and allowed to dry down standing before cutting and baling. This results in equally high quality feed. This method of harvesting is called making yellow-feed.

Two varieties of oats have been selected for their high leaf and stem production, which makes them desirable for green-feed production. These varieties are CDC Baler and CDC Bell. A newer variety, CDC Haymaker is a great addition to forage production in oats.

14. GRAIN STORAGE

SAFE STORAGE OF OAT GRAIN

CANADIAN GRAIN COMMISSION - Safe storage guidelines

https://www.grainscanada.gc.ca/storage-entrepose/ssg-de-eng.htm#oats

How to use the charts:

- Measure the moisture content and temperature of your crop as it goes into storage.
- Plot this initial moisture content and initial temperature on the chart. If the result falls in the no spoilage zone, then your crop should store safely for up to 5 months, 6 months in the case of wheat. If it falls in the spoilage zone, spoilage will occur.
- Cool or dry the crop in storage until the temperature or moisture content put it in the no spoilage zone.
- The centre zone cuts off a 1% safety margin although spoilage may occur under these conditions.
- Be aware that the moisture content and temperature of a bulk may change during storage due to convection currents, leading to localized spoilage. Monitor the top- centre of the bulk regularly throughout storage or use aeration.



Safe storage chart for oats

Oats: spoilage occurs when initial temperature ranges from 0°C to 21°C with respective moisture from 17% to 8% moisture content.

MONIORING GRAIN TEMPERATURE AND AERATING GRAIN

https://www.grainscanada.gc.ca/storage-entrepose/mta-stv-eng.htm

How temperature and moisture work

Grain is a very good insulator. When it is undisturbed, it holds temperature well. If warm grain is placed into storage and left undisturbed, convection currents develop and cause hot spots and moisture condensation. The greater the temperature differential (the difference between the temperature of the grain and the outside temperature), the stronger the convection currents. The stronger the convection, the greater the effect of heating and condensation on the grain. This is particularly evident when stored grain is not leveled and the grain bulk forms a peak.



The cycle of convection currents in bin-stored grain when ambient air outside the bin is cold and the grain is warm.

In the bin:

- The surface of the grain bulk forms a peak.
- Grain at the surface and just below the surface has high moisture content.
- Warm grain is located in the centre of the grain bulk.

Arrows represent the convection currents.

- Cold air flows down from the surface of the grain, along the interior of the bin wall. The flow of cold air surrounds the warm grain.
- At the bottom of the grain bulk the cold air is drawn to the centre of the grain by an upward flow of warmer air. The upward flow is a convection current created at the centre of the grain bulk.
- As the cold air is drawn to the centre of the grain, it warms up and flows up to the surface of the grain bulk where there is moist grain.
- The warm air is cooled as it reaches the surface, condenses, and the cycle is repeated.

Determining the moisture content of grain

Grain with a moisture above grade requirements can create an environment conducive to insect and fungal growth and development if it is not managed. Grain left unmanaged may increase in temperature and subsequent convection currents can cause surface condensation.

To determine the moisture content of grain at storage, take samples from bins every 3 to 4 weeks after storage if grain is not managed (no aeration or turning). Samples should be taken from several areas of the bulk and be kept in sealed plastic containers prior to testing.

Monitoring temperature

Check the temperature of the bin every 2 weeks. Measure temperature by using temperature sensing cables that are permanently installed or by probing the grain with an electronic sensor device.

If devices for measuring temperature are not available:

- Assess the general temperature by inserting a metal rod into the grain at the top of the pile near the centre. The rod should reach at least one metre into the grain.
- Leave the rod for approximately 30 minutes.
- Remove the rod and, with the palm of the hand, test it for warmth at various points from the tip. Any section of the rod that feels warm to the touch is an indication of heating and grain spoilage.

How aeration systems work

Aeration systems preserve stored grain and keep it dry by reducing the temperature of grain and reducing moisture migration. Appropriate aeration can prevent convection currents and condensation from occurring.

It is important to consider the physical characteristics of grain when considering aeration and drying. Factors such as grain class and storage configuration impact the static pressure and thus the aeration fan requirements. In general, as static pressure increases (e.g. increased height of the storage or change in the class of commodity in storage), the amount of time required to properly aerate also changes. Please consider consulting with your aeration system provider to determine aeration or drying times for the bin type or commodity that you have in store.



The movement of cooling and drying fronts through crops ventilated with air during autumn.

How to use aeration systems

Stored grains should be aerated as soon as possible after harvest, particularly if aeration can reduce the bulk temperature below 18°C. When the ambient temperature falls below that of the grain bulk, initially during the early evening, night, and early morning, you can use aeration to reduce the temperature of the grain.

If you aerate grain when the ambient temperature is above 20°C and the temperature of the grain is above 30°C, the odors produced will be more attractive to insect pests. Sanitation involving cleaning and treating grain is very important in preventing problems.

As well as preventing insect infestations, aeration is also very effective in controlling them. Once the grain temperature is reduced to below 18°C (which prevents insect feeding and reproduction) a further temperature reduction can be used to cause mortality. Refer to the disinfestation time periods required at low temperatures table in Physical control of grain insect pests.

Other cooling methods

If an aeration system is not available, turning grain outside the bin is an alternative to aerating it in the bin when the ambient air temperature falls below 15°C. Turn the grain every 2 to 4 weeks until the grain temperature reaches 15°C. This procedure involves removing about one-third of the grain from the bin and putting it back in the bin.

Grain chillers can be used to reduce the temperature of the grain when outside temperatures are above 20°C. Grain chillers reduce the temperature and moisture of air used to aerate the grain. Once grain is chilled it remains cool for extended periods, due to its natural insulating properties.

15. FURTHER TOPICS

Oat Links:

OAT SUSTAINABILITY http://www.namamillers.org/issues/sustainability/oat-sustainability/

OAT AS A COVER CROP (USA source)

http://www.sare.org/Learning-Center/Books/Managing-Cover-Crops-Profitably-3rd-Edition/Text-Version/Nonlegume-Cover-Crops/Oats

OAT PRODUCTION IN THE UK http://www.senova.uk.com/6-oat-top-tips/459397

OAT RESEARCH NEWS (World wide) https://oatnews.org/

