WSU FIELD DAYS

June 27, 1974
Dry Land Research Unit, Lind

July 11, 1974
Spillman Farm, Pullman

WELCOME TO THE FIELD DAY

The Field Day Brochure has been combined to include research at the Dry Land Research Unit, Lind and Spillman Agronomy Farm, Washington State University. Combining the information into one brochure will give you an opportunity to learn about the results of the wheat, barley, oat, pea, lentil and fertility research programs being conducted in all areas of eastern Washington. It is hoped you will find information that will help you in your farming program.

The plant breeding work and the studies on diseases, weed control, wheat milling and baking quality, and barley malting quality are cooperative projects of Washington State University–College of Agriculture Research Center and the U. S. Department of Agriculture–Agricultural Research Service, and supported in part by funds from the Washington Wheat Commission, Washington Pea and Lentil Commission, Washington State Department of Agriculture, Washington State Crop Improvement Associations, Hail Insurance Adjustment and Research Association, and the Pacific Northwest Crop Improvement Association. In addition many commercial companies supply cash grants and materials for specific research programs.

The University farms do not meet all the research needs for disease resistance and the effect of the environment on different plant types. Farmer cooperators provide land at no cost to research workers for the testing program. Without the cooperation of these farmers the research program would be curtailed. The cooperators are listed on the contributors' page in support of research.

This brochure is intended to provide you with a brief progress report and to present some of the highlights of the programs you will visit. The articles will be supplemented by discussions and exhibits at the various stops to be made on the Field Day Tours.

Reports from the research conducted by Washington State University, as well as from neighboring states, is part of the educational program of the Cooperative Extension Service. Publications covering many topics that will aid you are available in the county agent's office. You can obtain a copy of these publications by visiting your local county agent's office.

Edwin Donaldson, Chairman, Dry Land Research Field Day, Lind
Kenneth J. Morrison, Chairman, Spillman Farm Field Day, Pullman

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HISTORY OF DRY LAND RESEARCH UNIT

On April 1, 1915, Experiment Station Director I. D. Cardiff announced the establishment of the Adams Branch Experiment Station. It was "created for dissemination of information and conduction of demonstrations and experiments in the semi-arid portion of the state."

Adams County has played an important part in the history of the station. The county donated $6000 to start the station and the land has been donated by the county. In the early 30's during the depression, Adams County kept the station alive with a small appropriation until the College could fund the operation again. In 1965 Adams County deeded 318 acres to Washington State University, two acres was previously deeded to make a total of 320 acres in the Dry Land Research Unit.

The first superintendent was the late Dr. M. A. McCall. Dr. McCall was a gifted researcher given somewhat to philosophy in his early reports. In a 1920 report, he outlined the fundamental reasons for an outlying experiment station. He stated, "A branch station, from the standpoint of efficiency of administration and use of equipment, is justified only by existence of certain problems, which, because of special conditions such as climate, soil, etc., cannot be studied at a central station." For over fifty years this station has followed this policy of studying the problems associated with the 8 to 12 inch rainfall area.

In 1947 the station was named the Dry Land Experiment Station. This name was changed again in 1965 to the Dry Land Research Unit. In 1972, the administration of the station was moved into the Department of Agronomy and Soils. Although the administration has changed, the station is still devoted to dry land research. This experiment station has the lowest rainfall of any research station devoted to dry land research in the United States.

The present facilities include a residence and machine storage built shortly after the station was established. The old barn was dismantled in April 1973. A small elevator was constructed in 1937 for grain storage. A modern office and attached greenhouse were built in 1949 after the old office quarters were burned. In 1960 a 40' x 80' metal shop was constructed with WSU general building funds. In 1964 an addition to the greenhouse was built with a Washington Wheat Commission grant of $12,000 to facilitate breeding for stripe rust resistance. In 1966 a new deep well was drilled testing over 430 gallons per minute. A pump and irrigation system were installed in 1967. With the addition of a 12' x 60' trailer house residence, improvements in 1966 and 1967 amounted to over $35,000 with more than $11,000 of this from Wheat Commission funds and the remainder from state funds. The major portion of the research has centered around wheat. Variety adaptation, wheat production management including weed and disease control, and wheat breeding are the major programs of research in recent years. Twenty acres of land can be irrigated for research trials. Although many varieties of wheat have been recommended from variety trials by the station, Wanser and McCall were the first varieties developed on the station by plant breeding.

Since 1916 an annual field day has been held to show farmers and interested businessmen the research on the station. This year marks the 57th field day. Visitors are welcome at any time. Their suggestions are appreciated.

HISTORY OF SPILLMAN FARM

In the fall of 1955, 222 acres of land were acquired from Mr. and Mrs. Bill Mennet at the arbitrated price of $420 per acre. The money for the original purchase came as the result of a fund drive which raised $85,000 from industry and wheat growers. In addition $35,000 came from the Washington State University building fund; $11,000 from the State Department of Agriculture and another $10,000 from the 1955-57 operating budget. The dedication of the new facility took place at the Cereal Field Day July 10, 1957. In 1961 the Agronomy Farm was named Spillman Farm after the distinguished geneticist and plant breeder at Washington State University in the late 1880's.

Through the dedicated efforts of many local people and the initiative of Dr. Orville Vogel, arrangements were made to acquire an additional 160 acres north of the headquarters building in the fall of 1961. This purchase was financed jointly by the Wheat Commission and Washington State University. The newly acquired 160 acres was fenced and the wetland drained: It became an integral part of the Agronomy Farm now consisting of 382 acres.

The headquarters building, which is 140 feet long and 40 feet wide, was completed in 1956. In 1957 a well that produced 340 gallons per minute was developed. In 1968 the Washington Wheat Commission provided funds for a sheath storage facility, that was necessitated by the increased research program on the farm. At the same time the Washington Dry Pea and Lentil Commission provided $25,000 to build a similar facility for the pea and lentil materials The facilities of the Spillman Agronomy Farm now range in value well over a half-million dollars.

The Spillman Agronomy Farm was developed with proper land use in mind. A conservation farm plan which includes roads, terraces, steep slope plantings, roadside seedings, and a conservation crop rotation including alfalfa and grass has been in use since the Farm was purchased.

Paul Abendroth was the Spillman Agronomy Farm Manager until he retired last year. George Varner, who worked with Paul, was promoted to farm manager in the spring of 1974.

CLIMATIC DATA

The climatic conditions in the low rainfall area of eastern Washington commonly called the Big Bend Area, are unique when compared to Great Plains wheat producing areas. As shown in Table 1, about 90% of the rainfall occurs from September 15 to June 30. This rainfall pattern coincides with the normal winter wheat growing season. In most wheat production areas outside the Pacific Northwest, a spring-summer rainfall pattern occurs. The efficiency of the moisture utilization is greater under our rainfall pattern with lower evaporation-transpiration rates during the months of maximum precipitation in both summer fallow and crop years.

Table 1. Average temperature and precipitation at Dry Land Research Unit, Lind

Month	Temperature °F. Max.	Temperature °F. Min.	Precipitation 1973	Precipitation 1974	Precipitation 53 yr. av (in)
January	34	22	1.00	1.35	1.03
February	42	24	.23	.79	.87
March	53	32	.34	1.14	.72
April	63	35	.23	.67	.63
May	72	42	.60		.77
June	83	45	.23		.97
July	90	52	.05		.21
August	90	50	.02		.31
September	79	45	.75		.55
October	65	38	1.30		.89
November	47	29	3.35		1.20
December	37	26	3.02		1.25
			11.12		9.40

Climatic measurements are made daily with standard U. S. Weather Bureau instruments. Data recorded are maximum and minimum temperature, daily precipitation, relative humidity, daily wind movement, and daily evaporation. In addition, automatic instruments make a continuous record of soil and air temperatures and precipitation.

SOIL TESTING AND WEATHER

A. R. Halvorson
Extension Soil Scientist

Is the value of moisture and nitrate soil testing and importance of timing of soil testing related to weather? Yes! For example, the 1973 crop year was one of the driest on record, preceded by a severe winter that caused a considerable amount of winter kill on wheat.

What did soil testing show regarding the soil nitrogen situation following harvest after this combination of weather factors? It showed that nitrogen carry-over was related to yield. Generally, the higher the yield the lower the carry-over of nitrate N, and the lower the yield the greater the carry-over simply because of less N uptake by the crop. Simple - and about what one would expect but the only way to *know* how much was carried over at what depth it was located and *where* in the field there was carry-over, was through soil testing.

Following one of the driest crop seasons on record (1973), the 1974 crop season has been one of the wettest on record. What happened to all that 1973 carry-over N? By late January at the Agronomy Farm in Pullman it was already in the sixth foot of one location.

Is it important to know the carry-over N, at what depth it occurs and how it varies across the field, and when the weather can so drastically alter the soil nitrogen situation between the planning stage and the fertilizer application time? Yes - because it is not very often that climatic patterns vary as much as during the past two years. In fact a well planned fertilizer program based on soil test information will be the best program for more nearly normal years and even in unusual years it is a good tool. At least there would be some satisfaction in knowing why things went wrong!

For information on when to sample and how to go about it, check with your county agent or fertilizer dealer.

SOIL ACIDIFICATION STUDIES–SPILLMAN FARM

F. E. Koehler, A. R. Halvorson, and C. F. Engle

The use of ammonium type nitrogen fertilizers such as anhydrous ammonia, aqua ammonia, ammonium sulfate, and urea slowly increases the acidity of soils (decrease pH). This results from the release of hydrogen ions when ammonium nitrogen is oxidized to nitrate nitrogen. As the pH of the soil decreases, some soil fertility problems become worse and some new ones appear. Typically these include phosphorus fixation resulting from increased solubility of aluminum and iron; manganese toxicity; decrease in availability of certain trace elements (especially molybdenum); and calcium or magnesium deficiency. The severity of the problems varies with the soils involved and the amount of the pH decrease. While the general nature of the problems can be predicted, the specific problems and their importance can be determined only by actual experimentation. A knowledge of the exact nature of the problems and their solution is needed before they actually occur.

In this study, one third of the plots have been made acid by the addition of high rates of elemental sulfur which is oxidized to sulfuric acid by soil microorganisms, one third have been limed, and one third have been left at their natural pH. Some plots receive ammonium type nitrogen fertilizer (urea), some calcium nitrate and some receive trace elements. The experiment will be continued for a number of years to study the problems as they arise.

NITROGEN STUDIES IN THE LOW RAINFALL AREA WITH AND WITHOUT IRRIGATION–LIND

F. E. Koehler, Verlan Cochran, and E. E. Donaldson

This experiment is designed to study the movement of nitrogen fertilizer in the soil profile and the buildup, if any, in the soil over a period of years. Yield and nitrogen uptake by the wheat are also being studied. There are two plot areas so that each year one area will be in wheat and one summer fallowed. Rates of nitrogen are added at approximately 1/2, 1, and 2 times optimum rates. Half the plots receive supplemental irrigation and half do not. Yields, nitrogen uptake, protein content of grain, and nitrogen in the soil profile are being measured.

WHEAT, OATS, BARLEY

Kenneth J. Morrison
Extension Agronomist

Winter Wheat

Paha

Paha is a short, standard height, Omar-type white club wheat selection made at Pullman, Washington. The selection is shorter but in other characteristics is similar to Omar in appearance and in reaction to common and dwarf bunt. The high resistance to stripe rust was inherited from Suwon 92. It has moderate resistance to *Cercosporella* foot rot. The variety is superior to Omar in resistance to lodging, shattering, but is notably more susceptible to powdery mildew and flag smut. Good germination and emergence characteristics of the selection are similar to Omar.

Compared to Moro the variety is better adapted to the areas which consistently produce the quality of club wheat desired by domestic and foreign markets. Under conditions of relatively low rainfall and critical soil moisture at seeding time, Moro is expected to maintain its favorable competitive position principally because of ease of stand establishment and early maturity.

The high susceptibility of Paha to dwarf and flag smut is expected to retard its widespread adoption in the intermediate rainfall area.

Moro

Moro, a white club wheat with brown chaff was released by Oregon and Washington experiment stations and the U. S. Department of Agriculture. It was developed at the Pendleton Branch Experiment Station, Pendleton, Oregon.

Its chief advantage over Omar is that it is resistant to stripe rust. Moro is more resistant to dwarf bunt and common bunt also.

It emerges fast and yields the same as Omar when stripe rust is not a factor. When the disease is severe, Moro produces much better yields than stripe rust susceptible varieties.

Moro is a good pastry flour; however, it has a higher flour viscosity than older club varieties.

Moro is a medium tall club variety, about two days earlier maturing than Omar. Its kernels are white and has brown chaff. Moro does not have the high yield potential of Nugaines in the higher rainfall areas. The same fertilizer program is recommended for Moro as for Omar.

In the lower rainfall areas of Washington where it is difficult to obtain stands with Nugaines, Moro will germinate and emerge much better than Nugaines from deep seedings in dry, dusty seedbeds.

Nugaines

Nugaines is a semidwarf white winter wheat released for use in Washington and other parts of the Pacific Northwest where Gaines, which it closely resembles, proved to be well adapted. Outstanding superior characteristics of Nugaines are improved test weight per bushel and milling properties. The variety has a bearded, common-type head with white chaff. The kernels are classed as soft white. The head grows slightly more erect than Gaines.

Nugaines is not as winderhardy as McCall or Wanser hard red winter wheats, but is slightly hardier than the club wheats. Nugaines is similar to Gaines in hardiness.

Nugaines has good mature plant resistance to stripe rust. It also has more stripe rust resistance than Gaines, but less than Moro. Nugaines, like Gaines, is susceptible to stripe rust in the seedling stage.

Nugaines is similar to Gaines in resistance to all known races of common smut and most races of dwarf smut. Nugaines has moderate resistance to flag smut and stinking smut.

Luke

Luke is a soft white semidwarf wheat released to counteract the recent widespread appearance of new races of dwarf bunt. Parents of this variety include PI-178383 x Burt. 178383 was one of the parents of Moro. The result of this cross was then crossed with Selection 101, one of the high yielding semidwarf selections. Luke is resistant to all known races of common and dwarf bunt and is well adapted to areas where new races of dwarf bunt are found on Gaines and Nugaines. This variety is notably superior to these two varieties in resistance to *Cercosporella* foot rot, snow mold caused by *Fusarium nivale*, and to stripe rust.

The winterhardiness growth habits, and general appearance are similar to Nugaines. The milling quality is unusually good for soft white wheat, and the baking quality is similar to Nugaines. Its resistance to lodging, shattering, and leaf rust are slightly less than Nugaines. This selection is also susceptible to flag smut.

Sprague

Sprague is a soft white common wheat released for snow mold areas. The chaff varies from white to gray-brown; the heads are small and awnletted. The variety is 3 to 6 inches shorter than Wanser and McCall, and about 3 inches taller than Luke. Sprague heads about the same time as Wanser and McCall. It has high tillering capacity from early seedings, but the straw is weaker than Luke. The test weight of Sprague is below Nugaines but it has been above 60 pounds per bushel.

Sprague has good resistance to snow mold, stripe rust, and common bunt but is susceptible to dwarf bunt and *Cercosporella* foot rot. Reaction to flag smut is not known.

It has excellent emergence and adequate winterhardiness. The variety has survived in all snow mold trials in Washington. In the most severe test sites in Douglas County, commercial controls were not harvested while Sprague yielded 70 bushels per acre. Tests indicate that Sprague has sufficient yield to compete in severe snow mold regions in Washington. Its inferior plant type should preclude its use in other areas. The variety should be grown in areas where snow mold is a major problem. Because of its weak straw and lower yield, it should not be grown in more productive areas where snow mold is not a problem. The original crosses were made by the Dry Land Research Unit at Lind.

Hyslop

Hyslop is a soft white semidwarf winter wheat that yields well on dry land in high rainfall areas or with irrigation. Hyslop was developed at Oregon State University and tested in Washington. Hyslop has a slightly better yield record than Nugaines where winter killing is not a factor. Insufficient winterhardiness limits the use of Hyslop in eastern Washington. Cold hardiness tests showed that Hyslop lacks the winterhardiness of such varieties as Paha, Luke, and Nugaines.

Hyslop has more common smut resistance than Nugaines; it is resistant to stripe rust, moderately resistant to mildew, but is susceptible to flag smut.

Milling and baking quality of Hyslop are similar to Nugaines.

McDermid

McDermid is a semidwarf soft white common winter wheat. It has weaker straw than Hyslop and the head is awned. McDermid is adapted to the dry land winter wheat growing areas of the Pacific Northwest. McDermid has more winterhardiness than Hyslop but not as much as Nugaines.

McDermid is similar to Nugaines in common smut reaction but is susceptible to some races of dwarf smut. The variety is resistant to stripe rust and intermediate in reaction to mildew, Septoria and leaf rust. McDermid has shown a slightly lower yield than Nugaines in Washington. The variety has performed the best in the north-central area of Oregon. It is expected to replace Hyslop and Nugaines in some areas.

McDermid was developed by Dr. W. E. Kronstad, plant breeder at Oregon State University.

Coulee

Coulee is a semidwarf Burt-type hard white wheat selection made at Pullman. It is very similar to Burt in general appearance, winter and spring growth habits, winterhardiness, kernel type, and milling and baking qualities. The selection has shorter straw than Burt. It is slightly more tolerant to *Cercosporella* foot rot than Burt. The germination and emergence characteristics are very similar to Burt, representing an improvement over Nugaines and other relatively slow-emerging, semidwarf varieties. It is superior to Burt in resistance to stripe rust, lodging, and shattering.

Coulee was released in Washington for the production of strong gluten Burt-type hard white wheat desirable in the domestic and foreign markets. Tests indicate it is best adapted to good management in areas receiving between 10 and 14 inches of annual precipitation. When grown under relatively severe conditions of drought and severe freezing temperatures, it has shown no advantage in potential yield over Wanser or Burt.

Wanser and McCall

Wanser and McCall are hard red winter wheats developed for low rainfall areas of Washington. Both varieties yield as well as Nugaines in areas that have less than 11 inches of annual rainfall.

The two varieties can be distinguished by chaff color. Wanser has a brown-chaffed head; McCall, a white-chaffed head. Both have bearded, common type heads and medium height straw that resists lodging. Both varieties are resistant to common smut and most races of dwarf bunt. Wanser is highly resistant to flag smut.

Wanser is recommended for the southern half of the Big Bend. Its superiority over McCall in stripe rust tolerance and winterhardiness is important for maximum production.

McCall is well adapted to the northern section of the Big Bend area including Douglas, Grant, and Lincoln counties. McCall is superior to Wanser in both snow mold tolerance and emergence from deep seedings—two qualities important to production in this area. McCall recovers rapidly in the spring which is another advantage for the northern area.

Wanser is as winterhardy as Itana. McCall has good winterhardiness, though less than Wanser. Both Wanser and McCall are more winterhardy than Nugaines or the club wheats.

Wanser and McCall are more shatter resistant than Burt. They will shatter more than Itana, but are easier to combine and thresh clean.

Both varieties compare favorably with Itana in milling and baking characteristics. Wanser mills somewhat better than McCall. McCall has slightly better bread-baking quality than Wanser or Itana. Neither is suitable for production of soft white wheat products.

Wanser and McCall have higher yield potential than Itana, Columbia, or Cheyenne. Their potential is equal to that of Burt in the recommended areas.

Spring Wheat

Fielder

Fielder is a soft white spring wheat named and released by Washington, Oregon and Idaho Agricultural Experiment Stations and the Agricultural Research Service, U. S. Department of Agriculture.

Fielder has established a higher yield record than Twin or Marfed after three years' tests in Washington: at Pullman, Fielder averaged 60 bushels per acre compared with Twin's 55; Dayton, 55 bushels to Twin's 45; Walla Walla, 53 bushels to Twin's 47; at Pomeroy, 50 bushels to Twin's 41.

Test weight of Fielder averaged about 2 pounds per bushel more than Twin and about the same as Marfed.

Fielder is a semidwarf, stiff-strawed, white chaffed, awned variety with moderate resistance to leaf rust, resistance to prevalent races of stripe rust but moderately susceptible to mildew.

Fielder has the quality demanded for pastry use.

Fielder was developed cooperatively by the Agricultural Research Service, U. S. Department of Agriculture and the Idaho Agricultural Experiment Station.

Twin

Twin is a soft white spring wheat named and released by Washington, Idaho, and Oregon Agricultural Experiment Stations and the Crops Research Division, U. S. Department of Agriculture. Twin has a higher yield record on non-irrigated land conditions than Marfed. Twin did better under irrigation at Ellensburg but did not do as well as Marfed at Othello. Twin has a lower test weight than Marfed, it has shorter straw, and is more lodging resistant. The variety is resistant to prevalent races of stripe rust but is susceptible to leaf rust and mildew. Twin is an awnless wheat of medium maturity, has white chaff, and moderately stiff straw. The variety was developed at the Idaho Branch Experiment Station at Aberdeen, Idaho.

Marfed

Marfed is an early to mid-season common soft white variety with medium tall, stiff, white straw. It has a beardless, white-chaffed head. Marfed is more resistant to common smut than Federation. It tillers more than Federation, but otherwise is quite similar. When spring seeded, there is no lodging difference between Marfed and Federation. However, when fall seeded, Marfed has lodged somewhat more than Federation. Marfed resists shattering. It has fair seedling resistance to stripe rust and some mature plant tolerance. Marfed is recommended in the areas of eastern Washington with 10 or more inches of rainfall and for spring seeding in the irrigated areas of central Washington.

Idaed-59

Idaed-59 is a common soft white wheat that is very similar in appearance and growth habits to Idaed. It matures early and has short, medium stiff straw. Idaed-59 has a beardless, white-chaffed head. It has fair field resistance to stripe rust and is resistant to the stem rust in eastern Washington. It resists shattering. In late seedings, Idaed-59 matures from 7 to 10 days earlier than other spring wheat varieties. In the higher rainfall areas, it is well suited to late seedings on heavy soils and early seedings on shallow soils. Like Idaed, some dry area seedings may not be uniform in height at maturity, making harvest difficult. Idaed-59 is recommended for spring seeding in the 12-inch and higher rainfall areas and for late seedings on irrigated land in central Washington.

Wared

Wared is a hard red spring wheat released by Washington State University. The original crosses and selections were made in Minnesota as part of the U. S. Department of Agriculture, Agriculture Research Service, Minnesota State wheat research programs. Wared has an awned white-chaffed head with semidwarf plant-type growth. The variety is slightly earlier maturing than Marfed. Wared has a higher yield record than Peak 72, and appears to have excellent milling and baking quality when grown either on dry land or irrigation.

Durum-Wandell

Wandell is a durum wheat released for use under irrigation in the Columbia Basin and irrigated areas. Wandell is a semidwarf, spring, later-maturing, amber durum variety. It is resistant to mildew, stripe rust, and is very lodging resistant. It has light tan chaff and awns.

The original cross was made at the North Dakota Agricultural Experiment Station and additional selections made from that cross at Washington State University.

Wandell or other durum wheat varieties should not be growing where mixtures with other varieties may occur.

Spring Barley

Steptoe

Steptoe is a six-row spring feed barley with a higher yield record than Unitan or Gem. The test weight is higher than Gem and about equal to Unitan. Steptoe heads about the same time as Unitan and about five days later than Gem. The variety has stiff straw with better lodging resistance than either Gem or Unitan. The straw is about the same height as Gem, but 3 to 4 inches shorter than Unitan. The heads are erect with rough awns; the seed and the kernels are the same size as Gem, but slightly larger than Unitan. Steptoe is recommended to replace Gem and Unitan. The variety is not acceptable for malting.

The selection was made from an experimental selection crossed with Unitan.

Gem

Gem is a six-row, semi-rough awned variety of spring barley. It is high yielding and has stiff straw that resists lodging. It has white kernels, but is not acceptable to the malting industry. Gem is recommended for nearly all areas of eastern Washington and for irrigated areas in central Washington. It is not recommended in the Goldendale area or in the glaciated valleys of Pend Oreille, Stevens, Okanogan, Chelan, and Ferry counties.

Unitan

Unitan is a six-row barley with semismooth awns, white chaff, and white kernels. Kernel characteristics and test weight are similar to Gem. Unitan matures three to six days later than Gem. It is easier to thresh than Gem. Unitan is slightly taller than Gem and has about the same straw strength. In the lower rainfall areas, Unitan has yielded more than Gem. Unitan is recommended as a feed barley only in both the high and low rainfall areas of eastern Washington.

Blazer

Blazer, a six-row malting-type barley with rough awns, was released jointly by Washington State University, Oregon State University and the University of Idaho.

Blazer is expected to replace Traill and Larker, midwest malting barleys presently grown in Washington, Oregon and Idaho.

Blazer produces higher yields than Traill and Larker and has greater resistance to shattering and lodging.

Blazer yields in eastern Washington have averaged 500-700 pounds higher than Traill and Larker.

Test weight of Blazer is slightly lower than Traill or Larker, but plump kernel per cent is about the same as Traill.

The variety was developed by Dr. Robert Nilan and Carl Muir, barley breeders at Washington State University.

Piroline

Piroline is a two-rowed malting barley that has a higher yield record than Hannchen or Hanna, the standard two-rowed barleys that have been grown for malting purposes.

Piroline is awned, with white kernels, and has a stiff straw that resists lodging. Piroline is about a week later than Gem and is recommended in the higher rainfall areas of eastern Washington.

Vanguard

Vanguard is a two-row barley recommended to replace Piroline. The variety has a 250 pound per acre higher yield record than Piroline. It has better lodging resistance. Vanguard matures about the same as Piroline and is the same height. It is a two-row, spring barley with rough awns. The seed size is slightly smaller than Piroline. The variety was developed at Washington State University by crossing (Betzes x Haisa) x Piroline.

Klages

Klages is a two-row malting barley adapted to production with irrigation. The variety is not well adapted to low moisture dry land situations. Klages has been classified as acceptable for malting and brewing by the Malting Barley Improvement Association.

Klages has stiff straw and the beards are rough. It is mid-season in maturity.

The variety has excellent malting quality, but does not have as high yield record in Washington tests as Vanguard, but the malting quality exceeds Vanguard and Piroline.

Klages was developed by the University of Idaho and the Western Region Agriculture Research Service, U. S. Department of Agriculture.

Traill

Traill is a medium tall, six-row, spring malting barley. It matures a few days later than Gem. It has a rough, long beard and moderately stiff straw. The kernel size is small to medium. Traill may shatter if left standing after it is ripe. Traill is recommended for malting barley production in the high rainfall areas of southeastern Washington.

Belford

Belford is a six-row, hooded or awnless variety of spring barley. It is mid-season in maturity and medium tall. The straw is relatively weak. Belford is recommended for hay only in eastern Washington high rainfall areas and in central Washington under irrigation.

Winter Barley

Luther

Luther is a mutant selection derived from treating seed of Alpine with diethyl sulfate. Luther has a higher yield record than Alpine or White Winter. It is more lodging resistant than these two varieties because Luther is 5 to 7 inches shorter. Tests indicate that this short strawed mutant responds to fertilizer in most locations and can be fertilized with a minimum of lodging. Luther is more winterhardy than Alpine and considerably more winterhardy than White Winter.

Luther is a feed barley and is not acceptable to the malting industry.

Kamiak

Kamiak is a winter barley similar to Hudson in appearance. The selection has been tested at Pullman, Pomeroy, and Dayton, where it has produced higher average yields than Hudson. It is about equal to Luther in most locations. Kamiak is equal to Hudson in winterhardiness with slightly larger kernel size than either Hudson or Luther. It is more lodging resistant than Hudson with shorter straw, but it is slightly taller than Luther. The test weight of Kamiak is higher than Luther, but slightly lower than Hudson. The variety matures about the same as Hudson, but is at least 10 days earlier than Luther. Kamiak does not have small, glume hairs which cause "itching" during the threshing of Luther.

Kamiak should perform well in eastern Washington where Hudson is being grown.

Oats

Cayuse

Cayuse is a high yielding, moderately early spring oat recommended in Washington. It is a short, pale green variety with open and spreading heads. The straw is strong and resistant to lodging. The kernels are light yellow.

Cayuse has yielded 10 to 20 per cent more than Park in test plantings.

The main weakness of Cayuse is its test weight, which is relatively lower than that of Park. The test weight of Cayuse has averaged about 35 pounds per bushel in all Washington locations compared with 37 for Park.

Cayuse has some tolerance to the most serious oat disease in Washington—yellow dwarf or "red leaf of oats." The yellow dwarf tolerance of Cayuse can be seen mainly in its high yielding ability. Discoloration results after severe attack by aphids carrying the virus.

No other disease of consequence has attacked Cayuse in any Washington locations since testing began in 1959.

Although Cayuse is susceptible to node blackening and stem break, these diseases do not affect oat yield in Washington.

Park

Park is an attractive, stiff-strawed, high-yielding spring oat with plump, short white kernels It can be distinguished from most other oat varieties by its upright leaves, which are dark green in color. Park is a mid-season oat and is medium high. It rarely grows over 42 inches in height under irrigation. The heads are medium short and erect. Park has yielded about the same as Cody or Shasta. Park is recommended to replace Cody because it has more uniform straw height and kernel size. Park can be grown in eastern Washington in areas with 14 or more inches of rainfall, on irrigated land in central Washington, and in western Washington.

RECOMMENDED VARIETIES–WHEAT, OATS, BARLEY

AREA	WINTER WHEAT	SPRING WHEAT	OATS	SPRING BARLEY	WINTER BARLEY
EASTERN WASHINGTON					
14 inches or more rainfall	Nugaines Luke Paha Hyslop McDermid	Marfed Idaed-59 Twin Fielder	Cayuse Park	Steptoe Gem Unitan Traill–malting barley Belford–for hay only Piroline–malting barley Vanguard Blazer–malting barley	White Winter–18 inches or more rainfall Luther Kamiak
EASTERN WASHINGTON					
Less than 14 inches rainfall	Wanser McCall Moro Paha Nugaines Coulee	Wared–8-12 inches rainfall Wared–for reseeding in hard red winter Marfed–10 inches or more rainfall Idaed-59–12 inches or more rainfall		Unitan Steptoe	
CENTRAL WASHINGTON					
Under Irrigation	Nugaines Hyslop	Marfed Wandell (Durum) Twin Fielder	Cayuse Park	Gem Belford–for hay only	Luther
Douglas County (snow mold area)	Sprague				

CEREAL CROPS RESEARCH AT THE DRY LAND RESEARCH UNIT

E. Donaldson and M. Nagamitsu

The object of the Dry Land Research Unit's cereal breeding and testing program is to provide adapted cereal varieties to the Big Bend Area, where annual rainfall is less than 13 inches. The program includes testing new varieties and selections developed at other experiment stations throughout the Midwest and Pacific Northwest and foreign breeding programs. Within the total wheat breeding program in Washington State, the Dry Land Research Unit has primary responsibility for the breeding and development of hard red winter wheat and spring wheat. Virtually all of the breeding and development of white winter wheats is carried out by USDA personnel at Pullman, with the Dry Land Research Unit cooperating in yield testing. Yield testing of spring and winter barley and spring triticales is also conducted on the station.

Final testing is at selected locations in the Big Bend. These sites are now located on the Bill Schmidtman farm, and the Don Ogle farm, Waterville; Robert Kramer farm, Harrington; and Vollmer and Bayne farm, Horse Heaven Hills, with preliminary nurseries and demonstration plots occasionally located on selected farms.

All experimental work at the outlying locations is conducted by the same methods as the work at the Station. About 100 varieties and new selections from breeding nurseries are tested at these locations. Farmers in these areas are urged to visit the plots on county tours or at any other time. The results of these trials and those at the Dry Land Research Unit will determine the value of any new selection for the Big Bend Area.

Washington State University research personnel from Pullman conduct several nonbreeding wheat studies on the Dry Land Research Unit, including fertilizer management, moisture uptake and use, wheat physiology, disease and weed control.

HARD RED WINTER WHEAT BREEDING AND TESTING

The Hard Red Winter Wheat breeding program was started in 1951 with parent evaluation. Since 1952 crosses have been made each year to continually add new germplasm for yield, quality, winterhardiness, and disease resistance. Many crosses have been between high yielding white wheat varieties and the better yielding hard red varieties to improve the yield potential of adapted hard reds. Disease resistance is of major concern in the program and includes crosses for stripe rust, smut, foot rot, and snow mold resistance.

Every attempt is made to include a wide genetic background in the breeding program. Different types and sources of disease resistance are used to help prevent having only one source of resistance to any given disease. Many of the sources for disease resistance, winterhardiness, quality, or yield are not well adapted to the area and require one or two series of crosses (parent building) to get the desirable features into adapted varieties of high quality and disease resistance for the low rainfall area.

Recently we have observed that many of our new selections have considerably better emergence under adverse conditions of soil moisture and crusting than Wanser or McCall. Since stand establishment from deep seeding has always been a problem, we are stressing emergence ability in our breeding program. Last winter we spent considerable time developing laboratory techniques to evaluate speed of germination, germination at low moisture, and emergence from deep seeding. Although, our techniques are not yet fully defined, we can, with fair field correlation, test for rapid emergence from deep seeding under adverse conditions.

The yields of recommended varieties for low and intermediate rainfall areas of Washington and Oregon are given in Table 2. In Tables 3, 4, and 5 some agronomic characteristics of recommended varieties and the older varieties they replace are given for four locations in eastern Washington. These data are from rod row nurseries. Table 6 gives the data from large scale field plots at Lind. Data from these trials and other large scale field plots in eastern Washington are used to make variety recommendations. Variety recommendations for the different rainfall areas are included in this brochure in the section by Dr. Kenneth Morrison.

Table 2. Yield of selected varieties in low and intermediate rainfall areas in Washington and Oregon, 1964-73.

	Location and Rainfall				
Variety	Lind 9.5"	Moro, Ore* 11"	Pomeroy 14"	Pendleton, Ore 14"	Average
Nugaines	37.7	32.2	66.0	72.8	52.2
Luke**	34.6	35.2	62.6	75.6	52.0
Sprague**	22.1	34.5	60.1	74.7	47.9
Coulee**	31.3	30.9	56.5	69.4	47.0
Moro	37.3	31.9	57.4****	59.6	46.6
Paha	34.5	31.3	61.6	71.9	49.8
Wanser	35.8	33.1	53.6	67.4	47.5
McCall	37.4 ****	33.4	55.6***	66.3	48.2
Kharkof	31.7	27.5	48.7	53.2	40.3
Station Av.	33.6	32.2	58.0	67.9	47.9

*Moro location 9 years - 1965 missing
**6 year data, except Luke 4 year at Moro and Pendleton - Sprague 2 year (all locations)
***Not grown in 1972 and 1973
****Not grown in 1972

Table 3. Summary of agronomic characteristics of winter wheat varieties grown at Lind in rod row nurseries. 1952-73.

Variety	Av. plant ht.	Av. tst. wt.	1973 yield bu/a	Av. yield bu/a	Yield % Kharkof	No. years grown
Nugaines	24	62.1	17.4	37.7	122	9
Luke	23	60.8	18.1	34.6	122	6
Sprague	22	61.6	20.8	26.6	110	3
Moro	28	59.4	28.0	37.3	118	10
Paha	25	60.5	16.4	37.8	129	7
Coulee	23	62.2	13.2	31.3	110	6
Wanser	30	62.3	22.0	35.8	113	10
Kharkof	32	60.6	18.3	30.2	100	19

Table 4. Summary of agronomic characteristics of winter wheat varieties grown near Waterville in rod row nurseries. 1952-73.

Variety	Av. plant ht.	Av. tst. wt.	1973 yield bu/a	Av. yield bu/a	Yield % Kharkof	No. years grown
Nugaines	27	63.0	18.1	44.7	121	7
Luke	28	62.1	22.7	48.1	141	4
Sprague	27	62.9	27.6	36.8	124	2
Moro	34	60.0	23.7	44.2	118	7
Paha	28	61.8	16.7	44.5	126	5
Burt	32	61.6	*	40.2	114	15
Coulee	25	62.9	*	34.0	91	4
Wanser	34	62.8	24.1	41.4	111	8
McCall	34	62.9	30.6	43.6	116	7
Kharkof	38	61.6	26.5	34.5	100	17

*Not grown in 1973

Table 5. Yield in bushels per acre and percent of Kharkof for winter wheat varieties at two locations in rod row plots.

	HARRINGTON 1952-73			HORSE HEAVEN 1951-72		
Variety	No. years grown	% Kharkof	Av. yield bu/a	No. years grown	% Kharkof	Av. yield bu/a
Nugaines	8	142	40.6	3	127	20.2
Luke	5	147	39.1	3	121	19.2
Sprague	3	161	43.8	---	---	---
Moro	8	136	38.9	5	115	16.8
Paha	6	156	41.5	3	114	18.2
Coulee	6	128	35.9	3	120	19.1
Wanser	7	140	38.8	6	121	18.7
McCall	7	151	41.7	6	120	18.6
Cheyenne	---	---	---	11	115	19.7
Kharkof	20	100	34.7	13	100	17.8

Table 6. Summary of agronomic data for winter wheat varieties grown at the Dry Land Research Unit in drill strip plots. 1954-73.

Variety	Av. date head	Av. plant ht.	1973 yield bu/a	Av. yield bu/a	Yield % Kharkof	Av. tsts. wt.	No. years grown
Nugaines	5/30	24	15.9	37.5	122	61.3	8
Luke	6/2	23	12.7	35.7	113	59.8	4
Sprague	5/27	23	14.1	28.8	114	60.1	2
Moro	5/30	28	14.8	38.3	125	58.5	8
Paha	6/3	24	14.2	38.5	121	60.0	4
Burt	5/29	29	14.8	39.5	114	60.9	18
Coulee	5/30	23	13.2	35.1	111	60.8	4
Wanser	5/28	26	15.6	36.4	115	61.7	10
McCall	5/29	29	18.9	37.2	120	61.8	9
Kharkof	5/30	32	12.9	31.1	100	60.4	18

SOFT WHITE WINTER WHEAT IMPROVEMENT

C. J. Peterson, R. E. Allan, D. W. George, D. R. Henderson and J. V. Dearborn

The objective of the ARS-WSU Soft White Wheat Breeding Program is to improve the efficiency of wheat production in the Pacific Northwest. In order to attain this goal, new varieties must be coupled with improved management systems. Maximum efficiency cannot be obtained through breeding alone.

Six yield nurseries were sown in the fall of 1973. In addition to the ones at Pullman, Pomeroy, Walla Walla, and Harrington, a new one was added at Dusty, Washington. The nursery was sown at Dusty to check the performance of semidwarf, semi-standard and standard height lines.

Research on the identification of resistance to Cercosporella foot rot was expanded to include a nursery at Puyallup, Washington. In addition to testing our breeding lines for resistance to Cercosporella foot rot, 4,645 lines from the USDA World Wheat Collection were screened for resistance. Three hundred and fifty lines out of the 4,645 were identified as possibly having some tolerance or resistance. These lines were sown (fall, 1973) at Pullman and Puyallup, and they will be checked for resistance again this year. An additional 604 new lines were also included in the foot rot nurseries.

Cerco, a soft red semidwarf winter wheat, continued to exhibit good resistance to Cercosporella foot rot. It is being intensively used as a parent. VH 72730 was identified in 1972-73 as having good resistance to Cercosporella foot rot and flag smut. It is more winterhardy than Nugaines, but it is susceptible to leaf rust.

Flag smut was severe in the 1972-73 nurseries at Bickleton, Washington. Sixteen percent of the lines tested were resistant to flag smut. WA 5988 continued to exhibit high resistance to flag smut. It was placed in the State Extension Yield Trials and if it performs as well as Nugaines, we will recommend it for release. WA 5988 is a soft white, semidwarf winter wheat with good milling and flour quality. The winterhardiness of WA 5988 is similar to that of Nugaines.

A dwarf bunt screening nursery was sown in 1972-73 at Rice, Washington. The data obtained was very erratic because of the dry season. The test will be repeated in 1973-74. Fifty-seven lines were included in Dr. J. A. Hoffmann's dwarf bunt tests. Five of the lines were resistant to dwarf bunt. Two of these (WA 5988 and VJ 72287) are also resistant to flag smut.

C. I. 14482, a soft white semidwarf has been proposed for release. It is a facultative wheat with winterhardiness similar to that of Nugaines when seeded late. C. I. 14482 performs well from *late* fall and *early* spring seedings. It is susceptible to dwarf and common bunt and flag smut. C. I. 14482 is resistant to most races of stripe and leaf rust. The milling and flour qualities of C. I. 14482 are similar to those of Nugaines except that the flour of C. I. 14482 makes noodles superior to those of existing commercial varieties.

Twenty-two new lines in the 1972-73 yield trials were identified as being more winterhardy than Nugaines. Thirteen of these were retained in the yield nursery and will be given further testing for winterhardiness and other characteristics. The following table gives the survival rating and yield data for 6 varieties and 5 of the 13 new winterhardy lines.

Table 7. Survival Ratings and Grain Yields for 11 Winter Wheats During 1972-1973.

	Survival Rating	Harrington (Bu/A)	Avg.* Yield (Bu/A)
Nugaines	610	24	66
McDermid	438	18	68
Hyslop	77	13	64
Luke	434	21	66
Sprague	661	29	63
Paha	292	24	66
VB 72277	1,185	35	78
VB 72355	1,159	35	76
VH 072634	1,334	33	74
VH 071349	1,088	35	73
VH 071378	1,098	34	73

*Average yield obtained by combining the data from Pullman Early, Pullman Late, Pomeroy, and Walla Walla (1972-73).

YIELD AND ADAPTATION OF SHORT SEMIDWARF WINTER WHEAT TYPES

R. E. Allan, C. J. Peterson and J. A. Pritchett

We appear to be making some progress in developing semidwarfs shorter than Nugaines with high yield potential. It is this height level, often referred to as the "triple dwarf type," that has been successfully used by CIMMYT wheat breeders to gain new levels of yield potential. In 1973 we tested over 120 lines that were 5 to 25 cm shorter than currently grown semidwarf types. The yield results for 1973 were encouraging. Several lines yielded 35-69% above Luke in foot rot tests and 5 lines equaled Luke in the foot rot free wheat-fallow test. Ten lines exceeded the yield of Luke by 13 to 45% under irrigation and several surpassed its yield by 14-24% under annual cropping. The overall yields from four test sites in 1973 showed that 8 and 10 short lines equaled or exceeded the yield of Luke and Nugaines, respectively. The high yielding, short lines had narrow adaptation, however. None of the lines ranked in the top 10 for yield in all 6 tests conducted in 1972 and 1973.

STAND ESTABLISHMENT STUDIES

R. E. Allan, C. J. Peterson and D. George

A 3 year summary of one-gene semidwarf lines from the second cycle of recurrent selection identified 15 new types with superior seedling vigor traits. All of the new lines rated better than Luke for emergence rate (ERI) and several had ERI values comparable to Omar. Nine of the lines had total stand counts superior to Luke and five equaled Omar. Some of these lines had coleoptile and seedling growth rates 35 to 53% greater than Luke. These lines represent valuable parental material for future improvement in seedling vigor. They include nine different families and derive rapid emergence from Suwon 92/3* Burt, Nigger, Spinkcota and P. I. 178383. They were intercrossed this spring to establish the third cycle of recurrent selection for improved seedling vigor. The material is in preliminary yield tests for the first time this year. We plan to release several of these lines to wheat breeders throughout the world for germplasm.

We now may be able to test for seedling vigor more rapidly than we could in the past. During the last 2 years we have been checking the correlation between bulks and individual lines selected from the bulks for ERI and total stand. To date results have been encouraging and suggest that the best bulks generally produce the best individual lines. We have identified 52 different F_5 bulk populations that appear to have potentially valuable germplasm. This material represents crosses between elite lines selected from the World Wheat Collection for maximum coleoptile length and ERI value. We hope to be able to select markedly improved semidwarf lines from this material since 9 and 6 of these 52 populations had 2 year total stand counts and ERI values equal to or above Moro, respectively. There are over 6,800 individual F_5 semidwarf types in the field that are now under evaluation. Those showing the best agronomic potential will be rechecked for seedling vigor in 1974-75 and moved into our crossing program.

WINTERHARDINESS STUDIES

Donald W. George

Very dry seedbed conditions in 1973 discouraged early seeding, and unseasonably early snow with continuing wet weather in November prevented very late seedings in the medium to higher rainfall areas. The winter was not severe but localized winterkill was experienced.

The Winterhardiness Nursery at Central Ferry suffered a moderate degree of injury with several tender selections being eliminated and data generally confirming the results of a year ago. It is evident that in the recent past, we have had to accept a lower level of winterhardiness in our varieties than is desirable. Fortunately, it appears that we now have a good supply of hardier white seeded selections well along in the testing program.

No breeder willingly offers for release a variety which is known to be dangerously weak in any characteristic essential to successful production. Unfortunately, there have been serious problems in breeding and selecting for the complex character of winter survival. Planting date, stand establishment, and disease are some of the problems which influence the eventual survival of a crop. No variety will be accepted if it does not offer high yield potential and good quality, both highly complex characteristics themselves. In making selections for further testing and possibly eventual release, compromises are always necessary and, in the past, it has always been necessary to give up some (often measured) degree of winterhardiness in order to retain desirable yield.

We were never willing to do that and it now appears no longer necessary to do that. A number of the new white wheats are capable of yielding up to or above Nugaines and are at the same time significantly more hardy. Several of these are listed in Table 7, Page 26.

POSTHARVEST DORMANCY AND RELATED PROBLEMS

Donald W. George

Historically, postharvest dormancy has been a problem of summer rainfall areas. Wheat breeders have sought to maintain or increase the characteristic in their new varieties as a defense against grain sprouting in the head during rainy periods at harvest time with consequent loss of quality. The Pacific Northwest, with its dry harvest seasons, had little cause to worry about head sprouting.

With the advent of short-strawed wheat and with the realization that very early seeding might offer real advantages, postharvest dormancy was suddenly "discovered" as a problem. The hot seedbeds, sometimes with only marginal moisture conditions for emergence, were found to bring out the worst of postharvest dormancy. Poor emergence and poor stands resulted.

Soon after, Japanese wheat buyers began objecting to high alpha amylase activity in some of the grain shipments received in Japan and eventually this was found to be both a varietal characteristic and a result of head sprouting of a minor nature which had generally gone undetected in the past.

It appeared, then, that we needed both more and less postharvest dormancy; and in the same varieties, or a variety which is completely dormant until harvested but then loses all dormancy when threshed.

It appears that this is not a complete "pipe dream." Several breeding lines have been identified which, at least under some conditions, develop no detectable postharvest dormancy. And water extracts of wheat chaff have been found to inhibit germination, although not to a high degree. This may point the way of the future. Additionally, selections have been found which have a pronounced "nodding" head which sheds rain umbrella-like and is therefore, less liable to get wet enough to sprout.

In the meantime we have found that postharvest dormancy is not a reliable defense against head sprouting in our area. Our average minimum air temperature at Pullman during the July and August harvest season is below 50^{o} F. When the unseasonable rainy period occurs, temperatures usually are even lower. It has been shown experimentally that none of the varieties tested shows measurable postharvest dormancy when germinated at 50^{o} F, and postharvest dormancy is greatly reduced if germination is carried out at alternating hot and cold temperatures.

Therefore it now appears that postharvest dormancy is of little value to us in preventing head sprouting and can be a considerable handicap at early seeding time. This leaves the way clear for the breeders to work on low dormancy varieties which can be early seeded and will depend upon other (mechanical or chemical) protection from head sprouting.

Postharvest dormancy and head sprouting of some varieties and selections is shown in Table 8.

Table 8. Postharvest dormancy at harvest in 1973 at Pullman with percent head sprouting September 28.

	PI*		%
Variety or ID No.	Hand Threshed	Combined	Sprouted
Kharkof	2	34	28
Gaines	2	88	18
Nugaines	2	41	28
Luke	12	146	68
Hyslop	2	70	22
Sprague	12	169	66
Coulee	40	89	41
Paha	2	78	23
Moro	12	113	52
OR 6933	16	100	40
WA 5988	0	48	14
VH 72297	158	195	28
VH 72308	3	116	2
VB 72276	4	49	2
VD 68235	16	115	28
VB 72273	55	130	67

*PI (Promptness Index) measures promptness of germination and, therefore indicates presence or absence of dormancy. The range is from 0 to 200 with a high value indicating low dormancy.

FALL-SPRING NURSERIES

C. F. Konzak, E. Donaldson, M. A. Davis and M. Nagamitsu

This special series of trials is required for the evaluation and identification of spring wheats with high levels of cold tolerance and resistance to winter injury. Lines with higher levels of winter survival from a late September seeding have been identified. To test the vernalization requirement (spring habit) and maturity class of the cold tolerant wheats, a late May to early June seeding is made at Pullman. Some of the more promising cold hardy selections are already in the Western Regional Nursery, and the most cold hardy selections are being used increasingly in breeding. Increased cold tolerance is one important approach for increasing yield potential in spring wheats, because they will grow faster in the early spring when temperatures are normally cool. In addition, these spring wheats will have adaptation for reseeding or overseeding winter-injured stands of winter wheats, and in some areas with mild winters may serve as regular winter wheats. The wider use potential of the cold hardy spring wheats should increase the regular availability of seed of suitable spring wheat varieties when they are needed by winter wheat growers. Emphasis is being placed on increasing earliness and cold tolerance together in types with suitable quality and desirable agronomic characteristics.

HYBRID WHEAT STUDIES

R. E. Allan, C. J. Peterson and J. A. Pritchett

There are several problems that we must solve before hybrid wheat will work for our region. First, we need to find better R lines that will more fully restore hybrid male fertility. Second, we must find hybrids that have broader ranges of adaptation. Third, our best hybrids tend to produce proportionally more straw than grain and this limits their yield potential.

In order to get better restorer lines we evaluated 1010 test crosses last year. Many of these carried a new source of restoration from Europe called Primepi. Several contain the new source as well as two genes we have previously been working with. Based on fertility of the test cross hybrids, a few of the new R lines appear to be notably superior for restoration and have excellent agronomic potential as well. These lines have been used heavily this spring in crosses with three different A lines.

Hybrids again showed yield potential in 1973. They exceeded the yields of their high parent and Nugaines 22 and 38% of the time, respectively. The yield increases ranged from 1 to 49%. As in the past years hybrids exhibited specific rather than general adaptation. That is, individual hybrids yielded well at one site but produced poorly at another. It now appears that this drawback is mainly due to the restorer mechanism working properly at one test site but erratically at another site.

The severe winter afforded us a chance to study the inheritance of winter survival of the hybrids in relation to their parents. Increased survival was inherited as a dominant or partially dominant character in most cases Very few hybrids exhibited recessive control. These tests suggest that most hybrids would have winterhardiness like their most hardy parent so lack of winterhardiness in hybrid wheat should not be a problem.

We have made good progress in reducing losses due to lodging. Several hybrids with strong straw and 5 to 20 cm taller than Nugaines did not lodge and exceeded its yield. Most of these hybrids did not produce excessive amounts of straw when compared to their parents.

ADAPTATION AND YIELD POTENTIAL OF NEAR-ISOLINES OF WHEAT

R. E. Allan, C. J. Peterson and J. A. Pritchett

The wheat isoline studies are giving us valuable information on the relation of plant height to yielding ability. Yield and other agronomic comparisons were made between one- and two-gene isoline selections with their standard height sibs in genetic backgrounds of Omar, Burt, Brevor and Itana. One-gene semidwarf types consistently had higher yields than standard height types in all genetic backgrounds. Their yields averaged 42, 15, 13 and 3% above the standard height sibs in the Omar, Brevor, Burt and Itana populations, respectively. Semidwarf growth habit has limited value for Itana-type germplasm. The two-gene semidwarf lines yielded 27 and 24% more than standard height types in Omar and Brevor populations, but two-gene sib lines averaged 2 and 29% less than their tall counterparts in Burt and Itana genetic backgrounds, respectively. This means that two-gene semidwarf lines with Brevor and Omar rather than Itana germplasm have the best chance for increased yield potential. We need this short height level for the heavy soil, high rainfall and irrigated areas where one-gene semidwarf types lodge severely.

Tests on other isolines indicate that the awn is particularly essential for semidwarf types. Studies conducted on Burt and Brevor genetic backgrounds showed that the awn influences yield differently among diverse plant height types. Two- and one-gene awned semidwarf lines of the Burt type yield 3 to 5% more grain than their awnless sibs whereas the tall awned types yielded 9% less than their awnless sibs. The two-gene awned Brevor types yielded 11% more than their awnless types but the tall-awnless Brevor types outyielded tall-awned types by 10%. We need to make further studies on the relation of the awn to yield potential. It is important to identify those genetic backgrounds and plant height combinations that give us reduced yields when the awn is present and take this into account in our breeding program.

CERCOSPORELLA FOOT ROT, 1973–1974

G. W. Bruehl and R. Machtmes

Field Work

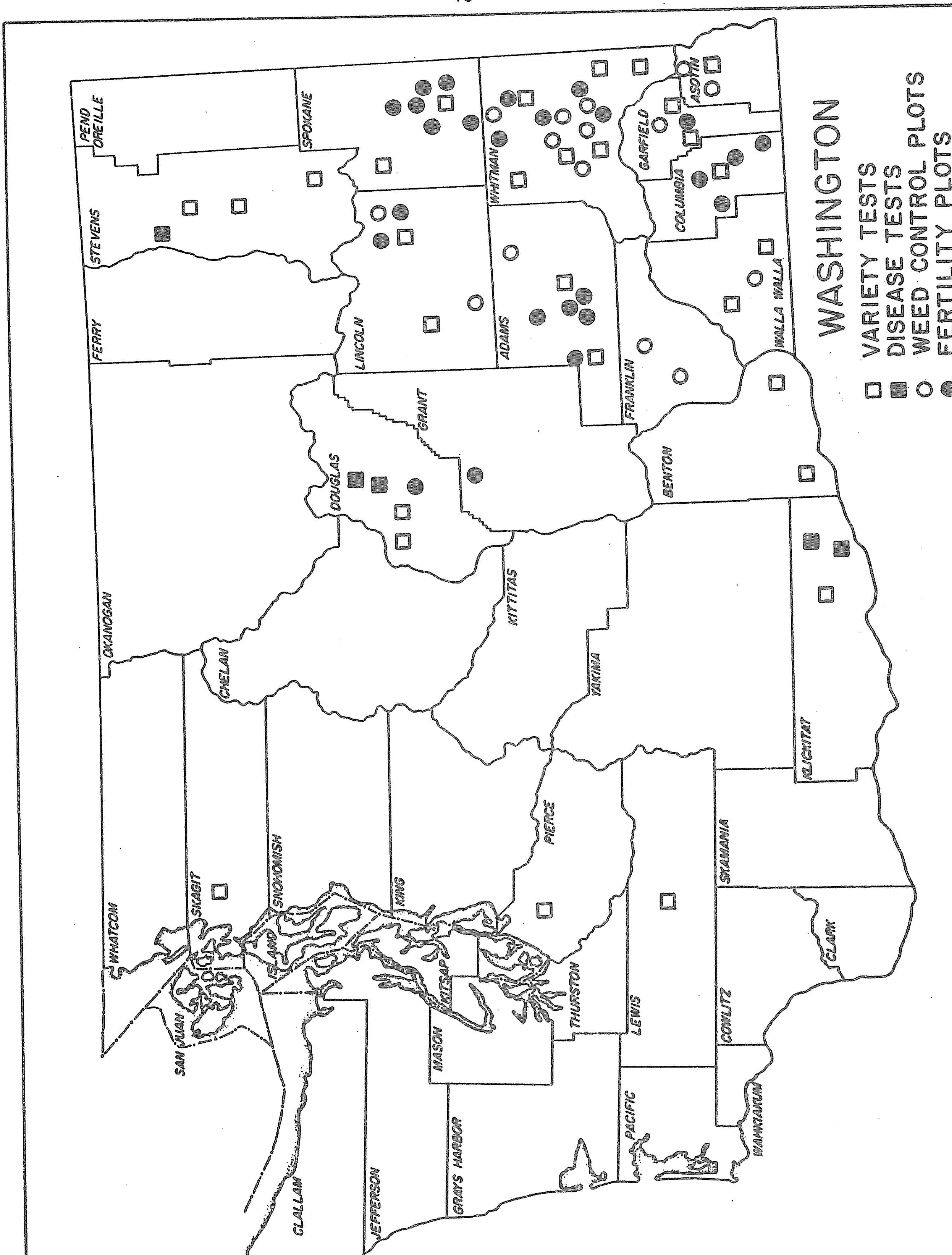
Dry weather at Pullman limited the value of foot rot experiments at the Main Experiment Station.

Foot rot developed well at Puyallup. The excellent cooperation of the personnel at the Western Washington Experiment Station is appreciated, as it enabled Palani Chidambaram to search for races of the pathogen and to attempt to rate the sources of resistance. This work will continue one more year. This fall we have the best materials of Bob Allan and the World Wheat selections made by Clarence Peterson under test. We plan a slight expansion at Puyallup this fall (up to three acres). Cerco, the foot rot resistant line of Dr. Peterson, continues to pass its disease tests. It should be a very valuable parent.

The main effort in fungicide testing is aimed at determining the curative powers of systemic sprays. We have not been able to predict the need for protection with certainty. If the fungicide could be applied after visible symptoms appear, a farmer would be more certain of applying fungicide only when and where it is needed. Rollin Machtmes is doing this work.

Greenhouse Studies

Palani Chidambaram is attempting to relate periods of susceptibility with stage of host development. He is also attempting to determine what part of resistance is due to subtle qualities and what part is due to visible characteristics such as cell wall thickness and toughness.


WASHINGTON
VARIETY TESTS
DISEASE TESTS
WEED CONTROL PLOTS
FERTILITY PLOTS
PEND OREILLE
STEVENS
FERRY
SPOKANE
LINCOLN
WHITMAN
ADAMS
GARFIELD
ASOTIN
COLUMBIA
WALLA WALLA
FRANKLIN
GRANT
DOUGLAS
BENTON
OKANOGAN
CHELAN
KITTITAS
YAKIMA
KLICKITAT
WHATCOM
SKAGIT
SNOHOMISH
KING
PIERCE
SKAMANIA
ISLAND
SAN JUAN
KITSAP
THURSTON
LEWIS
CLARK
COWLITZ
MASON
CLALLAM
JEFFERSON
GRAYS HARBOR
PACIFIC
WAHKIAKUM

SNOW MOLD RESEARCH, 1973–74

Field Observations

This winter was disastrous to winter wheat near and just north of Waterville, Douglas County. In this locality, summer fallow moisture was inadequate for normal seeding operations. Sprague, the most mold-resistant commercial wheat, seeded deep in dust emerged in a weakened condition, and it was either dead or too weak to save. Wheats seeded right after the rains were small (3-4 leaf stage), and they were all destroyed by the 150-day snow cover. All the resistant wheats seeded at Elton Polson's farm on September 26 died, even the resistant parents. Wheats seeded later, that entered the winter very small, escaped injury.

Summer fallow moisture was adequate or marginal west of Mansfield. In this region Moro seeded August 1 entered the winter with an average of nine tillers and all plants survived. Moro seeded August 26 averaged 4 tillers per plant and 10% survived. Sprague seeded August 15 averaged 14 tillers per plant and all survived. Sprague seeded August 26 averaged five tillers per plant when snow came and 60% survived. Omar seeded August 26 averaged 4 tillers with 0 survival. We learned that a good, vigorous well-established plant is essential; that resistance cannot overcome the effects of both poor summer fallow moisture and 150-day snow cover. The resistance of Sprague is adequate, if the plant is well-established (August 10-20 seedings in good moisture).

The nursery on the Harold Beard farm eliminated all but the most resistant wheats. Several new lines and segregating bulks look good. Clarence Peterson reported that a hard red selection made by Dr. D. Sunderman, USDA, Aberdeen, Idaho is far more resistant than Sprague. Its agronomic characteristics are not known, however.

Ed Donaldson and Dick Nagamitsu seeded a nursery deep in dust near Waterville on the Don Ogle farm. Some new lines with good emergence and mold resistance were revealed. Some emerged as well as Moro and lived. Moro emerged and died. So progress may have been made in two areas.

Laboratory Experiments

Dick Kiyomoto found that the virulence of *Typhula idahoensis*, the black "speckled" mold that kills most of the molded plants in Douglas and Okanogan Counties, is inherited in a complex manner. This fungus has two "sex" chromosomes and virulence is not regulated by either one. Dick Kiyomoto is also determining the rate and extent of carbohydrate storage, particularly in the resistant parents. A wheat that stores food very quickly and strongly would be able to withstand mold at more stages of development (maybe a plant with two or three tillers could be fully resistant, rather than having to attain greater size).

Rollin Machtmes has worked on ways to identify snow mold fungi.

RUST, POWDERY MILDEW, AND FLAG SMUT

R. F. Line

RUST

Three rusts occur on wheat in the Pacific Northwest (stripe rust, leaf rust, and stem rust). This year, 1974, stripe rust is more prevalent and more severe than it has been for several years, and it will probably significantly damage some fields of wheat. The unusually wet weather since September 1973, the mild winter temperatures, and the cool spring have provided environmental conditions that are favorable for the development of a severe stripe rust epidemic.

There are races of stripe rust, which are identified by their ability to attack certain varieties of wheat. From time to time new races that can attack previously resistant varieties may occur. To determine what races are present and where they are, we monitor the rust population. This is accomplished by planting a series of trap plots consisting of varieties that differentiate the races varieties with various types of resistance, and locally grown varieties and by collecting rust samples and testing them on selected varieties under controlled conditions. Four races are important in the Pacific Northwest (races PNW-1, PNW-2, PNW-3, and PNW-5); PNW-3 is prevalent throughout the area; PNW-1 has been confined to certain areas; PNW-2 was found in 1963 but has not been found since then; and PNW-5 was found on Moro near Bonners Ferry, Idaho, in 1968. It has spread to a few other areas but has not been observed this year. Moro is resistant to all races except PNW-5 and Paha is resistant to all races except PNW-2. These varieties have specific resistance. Nugaines, Gaines, Wanser, McCall, Luke, and Hyslop are susceptible to stripe rust in the seedling stage but are more resistant later in the season, especially when the temperatures are higher. These varieties appear to have nonspecific resistance (their resistance is the same for all races).

Most varieties of wheat grown in the region are susceptible to leaf rust. Leaf rust usually appears later than stripe rust, but can tolerate higher temperatures than stripe rust and can, therefore, increase to epidemic levels during the summer. The pathogen needs free moisture on the leaves in order to infect the plant; consequently, it is more severe when rains are abundant or frequent, in irrigated fields, and in areas where dew frequently occurs. Leaf rust can cause severe damage to the wheat crop. There are sources of resistance to leaf rust and resistance is being incorporated into new varieties. In recent years, stem rust has appeared late in the season when the wheat and barley crops were almost mature. Consequently, it has caused only slight damage to the crops.

As part of the total rust control program, we are testing fungicides to determine their effectiveness in controlling the rusts when applied at various rates and according to various schedules. Information has been obtained on the use of fungicides as a supplement to resistance and for protection when new races appear. Another aspect of rust research is studies to determine the amount of damage caused by various amounts of rust, under various conditions.

POWDERY MILDEW

Powdery mildew is prevalent throughout the region and is most prevalent in areas with higher rainfall and in irrigated fields. Accurate measurement of the damage caused by mildew is difficult to obtain. The amount of damage caused by mildew depends upon the amount of mildew and the environment and in general, is not as great as the damage caused by rusts.

Mildew frequently occurs in the same fields with rusts, consequently, studies on resistance to mildew and chemical control are often made in conjunction with studies on control of the rusts. Most varieties grown in the region are susceptible to mildew; however, there are good sources of resistance that are being incorporated into new varieties.

FLAG SMUT

Flag smut has been found in most counties of Washington and in a few counties of Oregon and is most severe in Klickitat County, Washington. It is only important in the Pacific Northwest. Varieties and lines have various degrees of resistance. Wanser is very resistant; Nugaines, Gaines, and Moro have relatively high degrees of resistance, Luke is moderately susceptible and Paha is very susceptible (more susceptible than Omar). A few new, systemic chemicals will control flag smut. Of those that are very effective, only Vitavax has been cleared by the Environmental Protection Agency for use as a seed treatment. It will control both seedborne and soilborne flag smut. Planting early and planting 2-3 inches deep increases the severity of flag smut. The higher temperatures in the early fall increase the disease. The effects of cropping sequence, tillage practices, and other management practices in relationship to flag smut survival and severity and the relationship of flag smut to yield and quality of wheat are being studied. It appears that the most effective control program for flag smut is the combination of several methods of controlling the disease.

BARLEY BREEDING AND TESTING PROGRAMS IN WASHINGTON

R. A. Nilan, C. E. Muir, A. J. Lejeune
K. J. Morrison, and P. E. Reisenauer

Barley improvement in the State of Washington consists of 1) an extensive breeding program at Pullman in which five different types of winter and spring, malting and feed barleys are being developed, 2) selection and testing programs at Lind (Dry Land), Davenport (Winterhardiness), and Royal Slope (Irrigated), and 3) testing programs in Eastern Washington at Pullman, Walla Walla, Dayton, and Pomeroy; and in Western Washington at Vancouver, Puyallup, and Mt. Vernon.

Following are brief descriptions of progress toward new varieties in the different types of barley under development.

In the winter barley program, both 6-row and 2-row types are being developed. Winterhardiness is one of the major limiting factors to widespread production. Nevertheless, significant advances have been made in developing more winterhardy, stiffer, and shorter strawed 6-row winter types. Luther and Kamiak are two new varieties from this program. Selection 1094-67 (Luther x 1255-60), a 6-row feed barley, has been recommended for release and appropriate seed increases are being made. It is mid-short and appears well adapted to both non-irrigated and irrigated land. It has been the top yielding selection in the Western Winter Barley Nursery for the past two years. It is more winterhardy than Luther and about as hardy as Kamiak and Hudson. Crosses have been made in an attempt to incorporate acceptable malting quality and high protein and lysine into this and other high yielding selections.

Winter 2-row types are being developed primarily for malting. Considerable progress has been made in increasing winterhardiness by using hardy 2-row types introduced from Germany which also appear to have good quality. Yield tests of the best new WSU 2-row selections have shown about a 10% increase in yield over Luther. Considerable emphasis is being given to this project because of the significant yield advantage, i.e., 25-30%, winter 2-row strains have over spring-sown 2-row varieties.

The spring barley breeding program includes the development of superior spring 6-row feed and malting types and 2-row malting types. Recent results from these programs are the very high-yielding 6-row feed variety, Steptoe, and the superior yielding 2-row malting type Vanguard. It is anticipated that Steptoe will take over much of the spring feed barley acreage in the Northwest. Vanguard was approved in 1971 as an acceptable malting type, being superior to Piroline in quality and yield. Crosses have been made to add malting quality and increased protein and lysine content to Steptoe and other high yielding spring-type selections.

This spring, Blazer (Washington 6704-62, Traill x 1038) was released as a potential replacement for the 6-row malting varieties Traill and Larker. The variety has consistently outyielded Larker and Traill by 10-15% and is significantly more shatter resistant.

DRY LAND AND IRRIGATION BARLEY TESTING PROGRAM

A general description of the barley breeding program and progress in producing new varieties of the winter and spring feed and malting types is presented on page 45.

The Lind Dry Land Research Unit is a valuable selection and testing location for winter and spring barleys being developed at Washington State University. Included in the winter yield trials are recommended varieties, Kamiak, Luther, and Hudson, along with Selection 1094-67 and other promising 6-row and 2-row selections.

In the spring barley nursery, Steptoe continues to outyield Unitan by a sizable margin; Blazer, the new malting barley selection, significantly outyields Larker; and Vanguard significantly outyields Piroline. Bulk early generation lines are being grown in order to select desirable and adapted lines under dry land conditions.

The winter and spring selection and testing program has been extended to irrigated areas. Very high yields with good plump kernels have been obtained at Royal Slope for several varieties and selections. Steptoe has outyielded Unitan by almost three-quarters of a ton. Two-row barley also produced excellent yields. Blazer has produced higher yields than Traill or Larker and did not shatter under irrigation. Quality of the malting types is also quite satisfactory. Thus, it appears that malting barley acreage might be profitably extended to the irrigated areas of Washington. This may be important since the demand for 6-row malting barley is increasing.

PULLMAN (SPILLMAN FARM) BARLEY BREEDING PROGRAM

Visitors at the Field Day at Pullman will have an opportunity to see in demonstration plots early and late seedings of sixteen current varieties and new advanced selections of 2-row and 6-row winter feed and malting barleys and 20 current varieties and new advanced selections of spring 6-row feed, of spring 2-row malting, and spring 6-row malting barleys. The main new varieties and most promising new selections were described in the general information on the barley program on page 45. Numerous other advanced selections will be demonstrated at the Field Day.

Some representative results from tests at Pullman are summarized in Table 9 for some of the more advanced selections and our new current varieties. Steptoe produces about 1,000 lbs. while Blazer, our potential malting variety, produces about 200 lbs. more yield than Unitan. Karl, the potential new malting variety from Idaho, yields slightly less than Unitan. Among the 2-row malting spring types, Vanguard still continues to outyield Klages, the new high quality 2-row malting barley from Idaho.

Among the winter feed barleys, the high yielding ability of Selection 1094 compared to Kamiak, Luther, and Hudson is shown. High yields, increased winterhardiness and plump kernels are being obtained among our 2-row winter selections bred for malting quality. The yield of Selection 2464 compares favorably with those of the 6-row winter varieties Luther and Kamiak and is much higher than the yield of Vanguard (spring sown).

The selection and testing program under dry land and irrigated conditions is described on page 45.

TABLE 9

COMPARATIVE YIELDS OF BARLEY TYPES

Pullman, 1970–72

(Lbs. per Acre)

Spring Type		Winter Type	
6-Row			
Steptoe (Feed)	4608	Sel. 1094-67 (Feed)	6566
Blazer (Potential Malting)	3888	Kamiak (Feed)	5760
Unitan (Feed)	3682	Luther (Feed)	5408
Karl (Potential Malting - Idaho)	3651	Hudson (Feed)	5200
Traill (Malting)	3515	White Winter (Feed)	4493
2-Row			
Vanguard (Malting)	3730	Sel. 2464-70 (Ack. 989 x R.T.H.) (Potential Malting)	5749
Klages (Malting)	3290	Ackerman's 989 (Potential Malting)	5462
Heines Hanna (Malting)	2869		

SPRING WHEAT IMPROVEMENT

E. Donaldson, M. A. Davis, and M. Nagamitsu

The spring wheat research in Washington is conducted as a coordinated program utilizing the the research facilities at Pullman (medium rainfall), Lind (low rainfall), and Royal Slope (irrigated) in the Columbia Basin. At these locations new varieties, lines, and plant selections are being tested, with each entry being evaluated at all locations during the same year. By this method it is possible to more quickly estimate the probable adaptation and potential of varieties and lines and to select those that warrant further testing.

Among the nurseries grown at the three locations several can be seen by those attending the field days, including the single plot nursery and the replicated nursery for preliminary testing of new selections, and the combined Western Regional and State Uniform Spring Wheat Nursery. In addition, the Regional Hard Red Spring Wheat Nursery from Minnesota, and observation plots of the International Spring Wheat Nursery from CIMMYT are grown at Lind. The International Spring Wheat Nursery is grown at Pullman. Single plant lines, and several nurseries of lesser interest are grown at both locations.

The major emphasis in breeding and selection will continue to be yield performance for specific and general conditions, with crosses being made to incorporate the necessary quality, disease resistance, and agronomic characters into single lines.

The 1973 Western Regional and Washington State Spring Wheat Nurseries include new varieties from the Washington State cereal research program and the states of California, Idaho, Oregon, Montana and Utah. Identical trials are being grown at the Pullman, Lind, and Royal Slope Research Units and in the vicinities of Walla Walla, Pomeroy, Dayton, Harrington, and Waterville on land provided by the cooperating local wheat growers. In addition to these larger replicated trials, released varieties are evaluated in replicated spring wheat nurseries throughout Eastern Washington.

Soft white spring lines include Marfed, a widely adapted variety with standard height and satisfactory milling characteristics. Idaed-59 is similar to Marfed with the exception that Idaed-59 matures earlier. Twin is a semidwarf, high-yielding variety; its test weight is usually lower than either Marfed or Idaed-59 when all are grown under similar conditions. WA5876 is a semidwarf derivative of Marfed and Gaines. It has dual purpose baking properties and superior milling characteristics. It represents a breakthrough in the quest for a better milling, common soft white wheat. It is also more cold tolerant than Marfed. Fielder is a high yielding, semidwarf wheat which produces grain having a higher test weight than Twin. The performance of these soft white spring wheat varieties in eastern Washington are shown in Table 10.

Table 10. Performance of Spring Wheats at 4 locations in Eastern Washington

Ave. Rainfall*	No. years grown	(20.5) Pullman Av. yield bu/a	% Marfed	(19.6) Dayton Av. yield bu/a	% Marfed	(20.0) Walla Walla Av. yield bu/a	% Marfed	(16.6) Pomeroy Av. yield bu/a	% Marfed
Marfed	5	47.9	100	44.1	100	45.3	100	36.7	100
Idaed-59	4	39.1	82	33.5	85	44.9	99	28.9	90
Twin	5	55.5	116	45.7	104	46.8	103	40.9	112
WA005876	4	56.8	113	44.6	96	48.5	108	45.3	116
Fielder	3	64.2	123	57.2	114	53.5	109	53.7	122

*Crop year - October 1 - August 30.

Spring Wheat

Tables 11 and 12 show the performance and agronomic characteristics of standard spring wheat varieties grown in the dry land region, Wared (Era Sib II), is a semidwarf hard red spring wheat with acceptable quality and fair stripe rust resistance. Wared is particularly suited to irrigated and supplemental irrigated culture, but will yield fairly well on dry land. Norana is a Montana hard red spring wheat which looks good for dry land culture from two years' data.

Table 11. Summary of agronomic characteristics of spring wheat grown at Lind in rod row nurseries, 1950-73.

Variety	Av. date head	Av. plant ht.	1973 yield bu/a	Av. yield bu/a	Yield % Marfed	Av. test wt.	No. years grown
Marfed	6/15	25	14.4	23.3	100	58.8	23
Twin	6/14	22	12.7	21.1	101	57.6	6
Idaed (Idaed-59)	6/9	25	8.9	20.0	86	56.4	23
Fielder	6/12	22	11.6	17.3	86	60.1	3
Gaines/Marfed S 68-3	6/18	23	16.0	21.2	102	60.3	4
Adams	6/11	26	11.8	21.7	95	59.4	8
Baart	6/11	28	*	21.3	88	60.2	21
Peak 72	6/10	21	10.0	17.2	83	61.2	4
Wared	6/15	21	12.0	18.7	88	60.2	5
Norana	6/14	20	13.7	15.4	103	60.2	2

*Not grown in 1973

Table 12. Yield in bushels per acre and percent of Marfed for spring wheat varieties at three locations in rod row plots.

	HARRINGTON			WATERVILLE			HORSE HEAVEN		
Variety	No. years grown	% Marfed	Av. yield bu/a	No. years grown	% Marfed	Av. yield bu/a	No. years grown	% Marfed	Av. yield bu/a
Marfed	23	100	30.5	22	100	30.1	20	100	18.0
Twin	5	99	29.4	5	106	29.6	5	94	11.6
Idaed (Idaed-59)	22	97	29.1	21	90	27.2	19	109	17.4
Fielder	3	108	32.1	3	100	29.5	3	101	15.3
Gaines/Marfed S 68-3)	4	99	28.7	2	95	27.8	3	106	16.2
Peak 72*	3	88	27.3	3	86	28.2	3	72	11.7
Norana	2	104	26.2	2	87	25.5	2	121	11.6
Wared	3	105	31.3	3	100	29.5	4	95	12.8

*Not grown in 1973 (all locations)

DURUM WHEAT BREEDING AND EVALUATION

C. F. Konzak, E. Donaldson, and M. A. Davis

Durum wheat research at W.S.U. is more limited in scope than that for hard red and soft white spring bread wheats, and the focal point of the work is toward the development of varieties primarily for irrigated culture. Yield trials are conducted at only one location in 1974, that being the Irrigated Research & Extension Unit at Royal Slope. The hybridization and early generation selection of superior plants will be concentrated at the Spillman Farm and Knott Dairy Farm in 1974. However, the W.S.U. durum research program enjoys close cooperation from breeding programs in California and North Dakota. Cooperative Western Durum Nurseries are grown in these states as well as in Idaho and Oregon. One high yielding, semidwarf durum variety, Wandell, was released in 1972. It has good quality and disease resistance, but its high yellow berry susceptibility and small seed size are weaknesses.

Objectives in durum breeding include increased yield to levels competitive not only with soft and hard red spring wheats, but also to levels competitive with winter wheats. Current varieties and lines are competitive with the best performing soft and hard red spring wheat varieties and test selections.

Also required in new varieties are semidwarf growth habit with lodging resistance, and resistances to mildew, stripe rust, and leaf rust. Most varieties and lines used as parental materials for crosses or mutation work carry high levels of rust resistance and some carry high mildew resistance also. Quality improvement remains the major problem. A rapid method for screening early generation materials (single plants) for semolina color has been developed permitting as much as an 80% reduction of F_3 progenies carried on to field testing from crosses of good x poor color durums. Larger seeds and more tolerance to yellow berry than Wandell also are required, but appear easily obtainable both in induced mutant material and in breeding lines. Future emphasis will be placed more on attaining the degree of "cooking tolerance" considered important for highest quality pastas. The cooperation of the USDA Hard Red Spring and Durum Wheat Quality Laboratory at Fargo, North Dakota is being utilized and two public supported laboratories in Italy and one laboratory in Argentina will cooperate in the evaluation of our advanced materials and sources of desirable high quality. Many valuable new breeding materials have been obtained already through the cooperation of Argentine and Italian scientists.

Parental materials are being developed which carry greater cold resistance than Wandell, considered important to the objective of consistent high yield performance and protection from injury by late spring frosts. As a part of this effort, winter durum lines and introductions from Turkey, Afghanistan, Chile, and the U.S.S.R. are being evaluated for cold tolerance, vernalization requirement, and winter survival in screening tests at Pullman. No materials from this program yet have sufficient cold resistance combined with desirable agronomic characteristics to include them in fall sown yield tests.

New sources of germplasm from the Chilean Breeding Program were planted in 1974 to be tested and reselected for adaptability to Washington conditions and evaluated for semolina characteristics in the laboratory. Improved sources of protein in durum wheat will be incorporated into the hybridization program in 1974.

Durum wheat has greater potential as a crop for Washington than is indicated by the limited production. Washington durum will find a place in both domestic and export markets. World consumption of pasta products made with durum wheat semolina is rapidly increasing and local uses are expected to increase when locally produced supplies of high quality durums are greater. Consumer preference is notably higher for spaghetti and other pasta products made of 100% high quality durum wheat semolina.

Durums will also fit well into crop rotations, especially for potato growers, and current varieties seem well adapted to the Ellensburg and Columbia Basin areas. The added advantage of the differential in freight rates also assures a market for an increased production of durum by Washington State wheat growers, reducing their dependence on markets for soft white wheats.

It should be noted, however, that durum wheats are a distinct class of wheat and must be maintained separately from soft white and hard red wheats as the quality and market value of both will be impaired. High protein content is an important marketing factor for durums. Current durum varieties, including Wandell, do not perform well under dry land conditions and are recommended only for culture under irrigation.

OAT BREEDING AND EVALUATION

C. F. Konzak, M. A. Davis, G. W. Bruehl,
K. J. Morrison, and P. E. Reisenauer

Oat research at W.S.U. is limited in scope with objectives to maintain or improve tolerance to barley yellow dwarf virus (BYDV) while improving yield, lodging resistance, and test weight. Little cross breeding work is being done; emphasis is placed on the evaluation of varieties from other stations. Recently, however, we have been exploring possibilities for improving protein content and quality and have made a few crosses toward that objective. Cooperation with the California breeders has made possible the isolation of lines with increased tolerance to BYDV from our cross of Cayuse x CI2874, two of the most BYDV tolerant sources isolated so far. The 1974 advanced oat nurseries under irrigation at the W.S.U. Royal Slope Research Unit and under dry land conditions at Pullman include lines from that program. The unusually wide adaptability of Cayuse seems readily recoverable in the progeny of the Cayuse/CI2874 cross. The lines being tested show promise for better yields, increased tolerance to BYDV, and equal or better test weight and groat percentage. The desired improvements in test weight seem more difficult to obtain, but new crosses have been made between sources of increased test weight and a line with the highest tolerance to BYDV isolated so far. This same line, now in regional tests, was used in crosses also with other sources for BYDV tolerance and with potentially high protein germplasm sources from the USDA World Collection. Protein analyses are provided through the kind cooperation of the USDA Quality Laboratory at Madison, Wisconsin.

A small mutation study is being conducted cooperatively with the Aberdeen, Idaho station and USDA to isolate materials with improved straw characteristics for irrigated culture, and a new mutation study was initiated in 1973 to improve the kernel size and test weight of the promising BYDV tolerant line mentioned above from the Cayuse/CI2874 cross.

The 1973 Northwestern States Regional Oat Nursery included largely new entries, mainly from the W.S.U. and Aberdeen, Idaho research programs. The six new W.S.U. entries are from the Cayuse/CI2874 cross, while several of the Idaho entries also have Cayuse as a parent. The remaining entries are promising lines from other programs in the United States and Canada. Cayuse has consistently maintained near the highest average performance in this nursery at all 16 locations over the past 7 years.

Eleven irrigated and 14 non-irrigated or dryland stations reported data for the Uniform Northwestern States Oat Nursery in 1973. Of the 25 entries in the 11 irrigated stations, WA6013 (Minn. II-22-220 x Cayuse) ranked first with an average yield of 152.4 bu/Ac., WA6015 was second yielding 152.0 bu/Ac., followed by WA6014 with 147.0 bu/Ac., and Cayuse at 144.4 bu/Ac. The highest entry-yield reported for the 11 irrigated stations was 218.4 bu/Ac. for WA6015 at Twin Falls, Idaho. At non-irrigated locations entry 71AB694 ranked first in yield with a 14-station average of 76.6 bu/Ac., followed by WA6014 with a 76.4 bu/Ac. average and 71AB716 with 75.7 bu/Ac. Cayuse produced 75.4 bu/Ac. and ranked sixth. Bushel weight for all oat entries at the 11 irrigated stations was 35.2 lbs/bu. and 32.4 lbs/bu. at the 14 non-irrigated locations.

DRY PEA IMPROVEMENT

F. J. Muehlbauer and J. L. Coker

The objective of the dry pea breeding program is to develop high yielding disease- and insect-resistant varieties adapted to the Palouse region. Root diseases of peas caused by a complex of several organisms are the major reason poor pea yields have been common to the area. Most of our efforts the past few years have been in identifying resistant lines for use as parental material, hybridizing the resistant lines with commercial varieties, and screening the resulting populations for root rot resistant segregants with good plant type and adaptability.

Fusarium wilt (race 1) reappeared in the Palouse region in the past two years causing economic loss in at least two pea fields. It was subsequently shown that the varieties being grown in these fields and several varieties of small sieve Alaska peas were wilt susceptible. This disease was a major problem in this area during the early 1930's but was successfully controlled through the use of resistant varieties. It is necessary, therefore, that varieties intended for use in the Palouse region be resistant to race 1 of *Fusarium* wilt. We are also aware of the other races of wilt that may become important in the future. For example, race 5 wilt has been responsible for taking nearly 30,000 acres out of pea production in Western Washington. In the event race 5 becomes a problem in the Palouse area, we have begun incorporating race 5 resistance into our early generation breeding lines.

In 1971 a program was initiated by G. R. Pesho, USDA Entomologist, to find host plant resistance to the pea seed weevil. That program was successful in identifying 16 lines of peas with apparent resistance to the insect. Eleven of these lines are currently being evaluated for resistance to the insect in replicated tests where yielding ability and adaptability will also be measured. In addition, we have begun a hybridization program to transfer the resistance to commercial lines. Preliminary observations indicate resistance to be associated with certain floral types. If this proves to be true, the early stages of breeding for resistance will be greatly simplified. Resistant varieties would be an ideal means of controlling infestations without the use of chemicals.

The pea leaf weevil, since its appearance in 1969, is another insect that has become a serious problem in the Palouse region. The problem may be compounded in the future depending on the restrictions placed on the use of DDT, the only known control measure. Because of this problem, we have begun a screening program designed to identify lines of peas resistant to the pea leaf weevil. If any lines are identified, they can then be used to develop resistant varieties.

LENTIL RESEARCH

Van E. Wilson

Major emphasis in lentil research is breeding for higher yielding varieties with disease resistance and improved seed quality. Plant introductions are tested to identify desirable yield and plant characters to use for improving lines and varieties by crossing and breeding methods.

Germplasm for highest seed yields has been identified in plants producing the smallest size seed. Other desirable characters identified are resistance to shattering, resistance to seedcoat cracking, winterhardiness, higher protein content in seed and more desirable processing traits. Germplasm for uniform maturity has not been identified.

The 10-year old lentil research program has moved from selecting and testing plant introductions to crossing, selecting, and testing progeny plants. Our breeding materials are derived from crosses made between red- and yellow-cotyledonous plant introductions. The red-cotyledonous parents were selected for high seed yield potential, bright seedcoat color, and resistance to seedcoat cracking. The yellow-cotyledonous parents were selected for large size seed, upright tall plant type, and vigor.

Field trials consist of 24 advanced breeding lines planted at Genesee, Idaho, and Colfax, Fairfield, and Pullman, Washington. In 1973, 10 of these lines yielded more than Chilean or Tekoa checks; of these, four had seed with protein content ranging between 28 and 30%.

Shatter resistant tests are made on all lentil lines in experimental trials. In 1973, Chilean and a red-cotyledonous line appeared to have the highest resistance to seed shattering while Tekoa ranked among the most susceptible to shattering. Lentil lines showing highest resistance to shattering in 1973 were most susceptible to shattering in previous years.

Winter hardy lentils, imported from Turkey by USDA's Plant Introduction Station, Pullman, were planted in the fall of 1973 and survived winter conditions without appreciable damage. Chilean, Tekoa, and experimental lentil checks failed to survive the winter test. In 1974, fall planted, winter hardy lentil lines began blooming on May 14, while the same lines planted April 30 were still in the primary leaf stage.

Research has begun to determine whether fall or spring planted lentils produce the higher yields. L. W. Hudson, Horticulturist, Plant Introduction Station, Pullman, continues to identify lines of winter hardy lentils in the World Collection of Lentils.

CONTRIBUTORS IN SUPPORT OF RESEARCH 1973–74

Fertilizers and Amendments

Cominco American, Inc.
Gardner & Smith
J. R. Simplot Company
McGregor Company
Ortho Division, Chevron Chemical Company
Northwest Plant Food Association

Herbicides and Pesticides

Amchem Products, Inc.
Geigy Chemical Corporation
McGregor Company
Rhodia, Chipman Division
Velsicol

Growth Regulators

Eli Lilly and Company, Greenfield, Indiana
Merck Chemical Division, Rathway, New Jersey
Rohm and Haas Company, Spring House, Pennsylvania

Farmer Cooperators

Variety and Disease Plots

Orin Anderson	Clyde
Harold Beard	Mansfield
Bud Benedict	Asotin
Elwood Brown	Bickleton
Clarke Farms	Albion
Richard Deffenbaugh	Kennewick
Jack DeWitt	Walla Walla
Diamond Spear Angus Ranch	Lamont
Jim Ferrell	Walla Walla
Paul Harrell	Ellensburg
Heirstuman Farms	Uniontown
Ed Hiller & Son	Ellensburg
Vern Hoffmann	Rice
Robert Kramer	Harrington
Quentin Landreth	Espanola
Merle Ledgerwood	Pomeroy
Lehn Brothers	Farmington
Carl Mielke	Harrington
Jack Miller	Chewelah
Woodrow Mills	St. John
Harold Naught	Bickleton
Arthur Ott	Addy
Kenneth Parks	Fairfield
Elton Polson	Waterville
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Ernie Stueckle	Dusty
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Lawrence Loebsack	Waterville
George Pitman	Oakesdale
Dan Plaster	Reardan
John Robinson	Pomeroy
Schelle Bros.	Waverly
Don Schultz	Davenport
Jim Scott	Pomeroy

Larry Gady	Rockford
Harold Gorham	Walla Walla
H. J. Clauson & Son	Spokane
Earl Hill	Spangle
Holling Brothers	Spokane
William Jacky	Reardan
Norman Kagele	Ritzville
Ed Kilpatrick	Oakesdale
Lloyd Sevier	Walla Walla
Ken Sieveke	Tekoa
Woodsie Smith	Ephrata
Fred Stueckle	Lacrosse
Elmo Tanneburg	Coulee City
Clayton Walker	Coulee City
Jake Weber	Schrag
Don Wellsandt	Ritzville
Bill Zagelow	Odessa

Weed Plots

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Albert Bruce	Farmington
John Daily	Palouse
Francis Fitzgerald	Clarkston
Vince Hensle	Colfax
Kenneth Hufman	Othello
Edwin Koller	Pomeroy
Fred Mader	Colfax
Ben Stueckle	Colfax
Morton Swanson	Palouse
Lyle West	Palouse
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Del Wisdom	Basin City

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Barley Research

Malting Barley Improvement Association

LISTING OF COOPERATIVE PERSONNEL AND AREA OF ACTIVITY

Glenn Terrell . . . . President, Washington State University
J. S. Robins . . . . Dean, College of Agriculture
J. Nielson . . . . Director of Research, College of Agriculture
A. W. Peterson . . . . Acting Director of Cooperative Extension
J. C. Engibous . . . . Chairman, Department of Agronomy and Soils

Cereal Breeding and Genetics

R. E. Allan and J. A. Pritchett, Cooperative USDA, Pullman . . . . Wheat Genetics
E. Donaldson, Dry Land Research Unit, Lind . . . . Wheat Breeding
D. W. George, Cooperative USDA, Pullman . . . . Plant Physiology
C. F. Konzak, M. A. Davis, and R. Hu, Pullman . . . . Wheat Breeding & Genetics
R. A. Nilan, A. Lejeune, and C. E. Muir, Pullman . . . . Barley Breeding & Genetics
C. J. Peterson, Cooperative USDA, Pullman . . . . Wheat Breeding

Cooperative Regional Wheat Quality Laboratory

G. L. Rubenthaler . . . . Chemist in Charge, Wheat Quality Laboratory
S. J. Kitterman . . . . Research Chemist
W. F. Sollars . . . . Research Chemist
H. Jeffers . . . . Experimental Miller
P. Anderson . . . . Experimental Baker

Cooperative Varietal Testing

S. E. Brauen, Puyallup
P. C. Crandall, Vancouver
S. M. Dietz, Central Ferry
E. Donaldson, Lind
S. Haskey, Puyallup
K. J. Morrison, Pullman
C. E. Muir, Pullman
M. Nagamitsu, Lind
R. A. Nilan, Pullman
P. E. Reisenauer, Pullman
C. J. Peterson, Pullman

Cereal Diseases

G. W Bruehl, Pullman . . . . Cereal Viruses, Foot Rots, Diseases Other Than Smut
R. J. Cook, Cooperative USDA, Pullman . . . . Root Rot Diseases
J. W. Hendrix, Pullman . . . . Stripe Rust on Wheat
R. F. Line, Cooperative USDA, Pullman . . . . Flag Smut Control

Soil Testing

A. R. Halvorson, Pullman

Seed Testing

J. D. Maguire, Pullman

Cereal Crop Improvement

A. G. Law, Pullman
J. D. Maguire, Pullman
T. D. Wagner, Pullman

Farm Manager

G. F. Varner, Pullman

Fertility & Management

F. E. Koehler, Pullman
Marv Fischer, Pullman
R. I. Papendick, Pullman
V. L. Cochran, Pullman
E. T. Field, Pullman
C. F. Engle, Pullman