

Yield-Maturity Relationships in Spring-Planted Crops for the Northern Canadian Prairies

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On the northern and northwestern Canadian prairies yields of cultivars or varieties of annual crops tend to be positively associated with days to maturity. Early maturing varieties tend to yield poorly, and top yields are found among the latest maturing varieties of a crop. However, early maturity is very important to the producers where frost and poor harvest conditions are a hazard. Thus, early maturing varieties tend to make up a larger proportion of the area given to a particular crop, as average climatic conditions related to shortness of the growing season become more severe, until at the edge of the areas limited by climate for annual crops, only the earliest maturing varieties of those crop species adapted to short, cool season, environments, are common. Perhaps the most striking instance of this in Canada is north of Fort St. John in British Columbia. In certain parts of this area, where annual crops give way to forage production, one can drive for miles and see mainly the early maturing varieties Otal and Jackson.

Among the reasons for higher yields in later maturing varieties in the north, are limited heat units for growth, lower levels of late season leaf diseases, and escape from severe high temperatures and mid-summer drought.

For the breeder, who is developing varieties for this area, the limited number of heat units imposes theoretical if not immediate limits. The very low incidence of some of the leaf diseases frees the breeder to pay more attention to selection for yield and agronomically useful characteristics. Drought tolerance is important, particularly in the most northern part of the Peace River region, but the northern prairies as a whole tend to escape the devastating effects of hot drying winds which are more common farther south and west.

I have 13 yield-maturity graphs I want to show you, outlining some of the situations found in the Alberta Regional Trials grown in the Peace River region of Alberta and British Columbia. They cover barley, oats, the wheats, triticale, and canola.

Comments on the Figures.

The area we are talking about is the northern fringe of the main part of the agricultural portion of western Canada, and the Peace River region (Fig. 1). In Figure 2, the Yield-Maturity Graph for barley, of the Alberta Regional Trials, Peace River Region, you can see how the varieties Otal to TR224 are strung out along a yield-maturity line. They are: Otal, Jackson, BT663, BT665, BT917, Johnston and TR224. These varieties have a superior yield-maturity performance to the others on the graph, which are below and to the right. In this barley test, the days to maturity range is from 88 to 103 days. The yields, as a percent of Galt, range from about 84 (for the hulled varieties) to 116. You can see that considerable progress has been

made in improving the yield-maturity performance of barley over the last ten years. Most of the older varieties are in the lower right handed part of the graph. The varieties in this test are either currently recommended in Alberta, or are under test for this purpose. There are about 12 test sites averaged in this test, as there are for the regional trial tests for oats, CWRS wheat, and flax.

In Figure 3, you can see the same general relationship between yield and maturity. This is a ten site test, three in the Peace, and the rest in central Alberta. Varieties from this test go into the cooperative registration trials. Entries are from the Lacombe and Beaverlodge Research Stations.

Figure 4. In this test, The Great Plains Barley Nursery, the maximum yield-maturity line is not so clearly marked. Most of the test sites are in the northern United States, from Minnesota, west. Primus II was released as an early maturing variety designed to escape mid-summer drought. This is in contrast to the varieties Jackson and Otal, which were registered for sale in Canada to provide farmers in the north with early maturing varieties that would escape frost.

Figure 5 is a yield-maturity graph for oats. It is from the Alberta Regional Trials, Peace River Region. Note that there is only about a 6 day spread between the early maturing variety, Athabasca, and the latest maturing variety, Dumont. Note that the drop in yield from OT755, at the top right, to Athabasca is 23% for only 5 days, or 4 to 5 percent per day. This is in contrast to the Regional Trial barley, where the drop in yield is about 2 percent per day.

Figure 6 is an example of a multi-site yield test from the oat breeding program at the Agriculture Canada Research Station at Lacombe, Alberta. There are six sites in this test. Outstanding lines from this test, such as OT755, at the top right hand of the graph, go into Cooperative registration or licensing trials. Again here you can see evidence of a yield-maturity barrier.

Figure 7 is the Yield-Maturity Graph for Canada Western Red Spring Wheat from the Alberta Regional Trials, Peace River Region. The maturity range is about 7 days, and the range in yield about 12 percent.

Figure 8 is the corresponding Alberta Regional Trials, Yield-Maturity Graph, for Other Wheats and Triticale, Peace River Region. The station years are quite limited for the newer selections, as the test is only grown at two sites per year in the region. However, the spread in maturity for the wheats is about seven days, and the yield range about 35 - 40 percent. For the triticales, T54 through Welsh, the yield-maturity performance is similar, but at a lower level of production.

This (Figure 9) Graph is of the Parkland Wheat Co-operative, 1987. HY320, Oslo and Wildcat constitute an advance in yield-maturity performance over the older Canada Western Red Spring (CWRS) varieties, Neepawa and Park. The test varieties on the upper left hand side, are Canada Prairie Spring (CPS)

selections. The lower, earlier, ones are CWRS. The challenge for both of these quality types is to develop material that will plot farther up and to the left. This is more difficult with the CWRS wheats, because of the high quality standards needed. We, at Beaverlodge, have some unadapted germplasm several days earlier maturing than the material shown on this graph.

Figure 10 is the Alberta Regional Trial, Peace River Region, Yield-Maturity Graph for Durum Wheat. The station years are limited. There has been no breeding of Durum wheat in the Peace River Region. The yields are considerably lower than for the other wheats, about 11 percent lower than the Canada Western Red springs, based on Beaverlodge and Fort Vermilion means of comparable tests. There may be a cold tolerance problem with Durum wheat.

Going now to Canola, the comparable regional trial graph, Figure 11, (Yield-Maturity Graph for Canola, Alberta Regional Trials, Peace River Region.) is empty in the middle, particularly as compared to the barley graph. There are really only two registered varieties that show up well on the graph, Westar (Brassica napus) at the top, right, and Tobin (B. campestris) at the bottom left.

Figure 12 (Yield-Maturity Relationships, Brassica napus 1987-600 Tests) shows one preliminary attempt to fill this blank, from the Argentine, or Brassica napus, side. The 'W' stands for Westar. The other three points are averages of several related lines each. Note that the oil percentage has dropped, particularly in 'A', in spite of selection for this characteristic. With more plant breeding work this may or may not constitute a serious limitation to the development of earlier maturing, high oil, B. napus types.

Figure 13 (Yield-Maturity Relationships, Brassica campestris 1987-300 Tests.) shows another preliminary plant breeding attempt to fill this gap, this time from the Brassica campestris side. In this particular set of material the mean values for yield show no improvement over Tobin, but with the later maturity, the oil percentage is improved. This is suggestive that there may be some tendency, in both the Argentine and Polish species, for oil content to go up with later maturity, under at least northern Canadian prairie conditions.

Figure 14 is the Peace River Region, Regional Trials, Graph for Flax. It is based on a minimum of 16 station years. Due to the large number of days to maturity for flax, 117 to 123, as shown here, the earliest maturing Noralta, an old variety, is still the one I would recommend for the Peace. It was selected at Fort Vermilion.

As you can see, each of the several species have their own specific needs for improved adaptation to the north.

In barley, the six-rows appear to be better adapted morphologically than the two-rows to cool, short season conditions. However in the Peace River part of the Alberta Regional Variety Recommendation Trials, the late maturing two

row, TR224, had the highest yielding average in 1987. In spite of strict quality requirements, some of the higher yielding mid-season lines under test have promising malting quality. With continued plant breeding efforts, progress will be made in disease resistance, and agronomic characteristics, in early maturing varieties. Earlier maturing malting types will also be developed. Northern European germplasm will continue to be important.

In oats there have been major advances in yield in both early and late types in recent years, and it would appear that with continued plant breeding effort further progress, perhaps major, will be made, particularly in the early maturing material.

The necessity of maintaining and improving bread making quality in the CWRS wheats has severely limited the speed with which yield advances have been made. Backcrossing for earliness may be an option in improving adaptation for northern areas. Major yield advances have occurred in the other hexaploid wheats, in the mid-season and later maturing types. It stands to reason therefore, that with continuous plant breeding work over the next ten to fifteen years, excellent progress should be possible in the development of early maturing varieties. CIMMYT germplasm has contributed in a major way to the Beaverlodge wheat breeding program. CIMMYT seems like an unlikely source, for this, since a lot of their breeding work has been targeted at the lower latitude parts of the world. However the intensity of their breeding work has resulted in lines of value generally, and not just for the areas of intended use.

The durum wheats do much more poorly as a whole than the bread or hexaploid wheats. Germplasm may not be available to adapt them to northern conditions.

Canola quality rapeseed, and perhaps also mustard (Brassica juncea), appear to have tremendous potential for improvement. Canola is a new crop in its western Canadian form. Intensive plant breeding efforts should continue to pay handsome dividends right across the maturity spectrum.

Flax is no longer an important crop for northwestern Canada, and it appears to have little or no prospects for major increases in acreage.

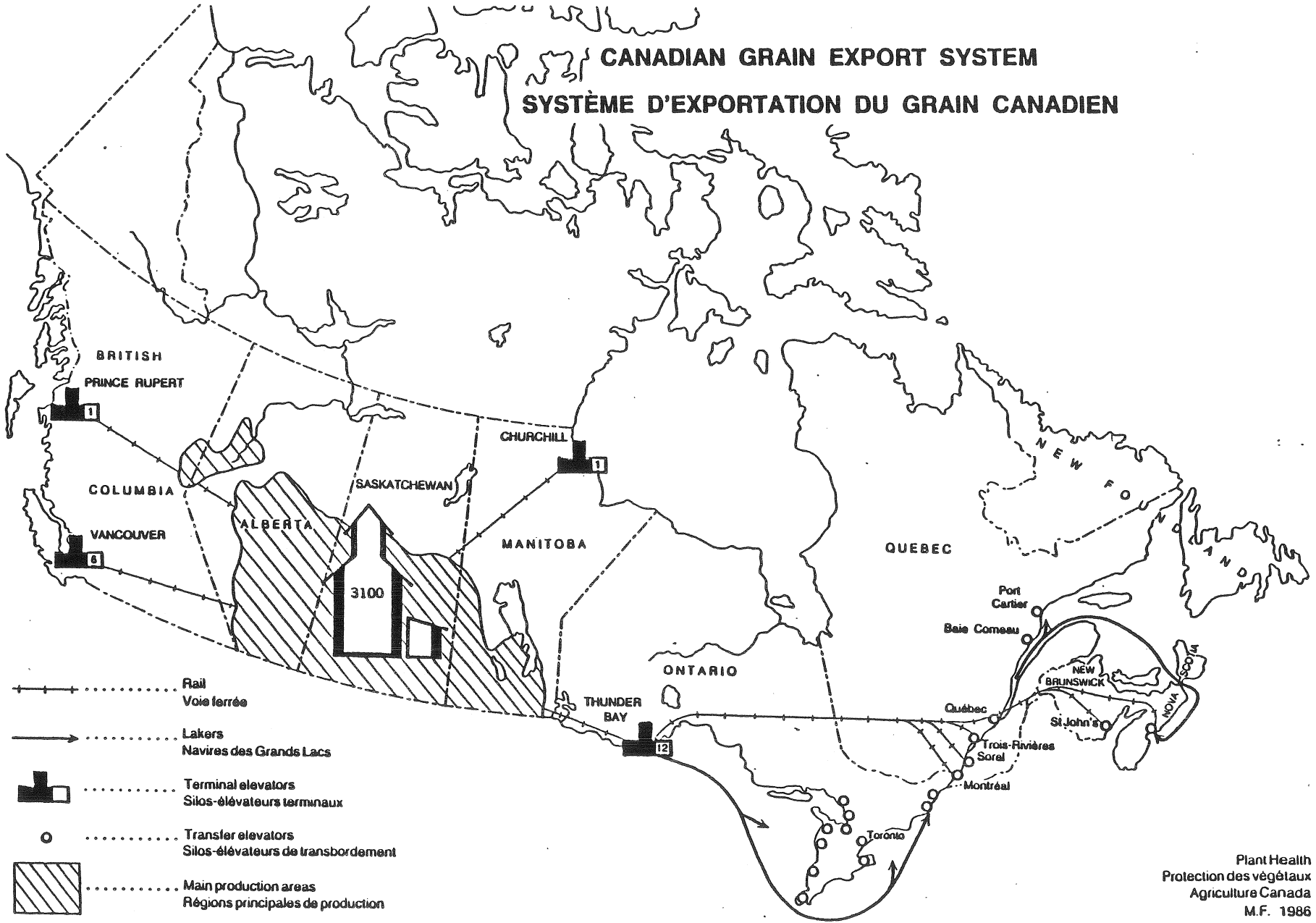
In the breeding programs for the area much of the selection effort is on progeny of locally adapted Canadian varieties. However new sources of germplasm are also very important. Advanced breeding lines and varieties have and will continue to be imported from northern Europe, perhaps also Alaska, and other parts of the world. The challenge will be to make adequate use of the available germplasm. Individual genes will continue to be incorporated from various sources, both wild and domesticated, for such things as earliness, and disease resistance. Along with these may come genetic material in other parts of the genome, or gene complement, that may also contribute to productivity.






List of Figures.

- Figure 1 Map of Canada, with western grain growing areas highlighted.
- Figure 2 Yield-Maturity graph for barley. Alberta Regional Trials, Peace River Region.
- Figure 3 Yield-Maturity Relationships, 1987 Northwestern Canada Barley Tests.
- Figure 4 Yield and Date Headed, USDA-ARS Great Plains Barley Nursery, 1981.
- Figure 5 Yield-Maturity Graph for Oats. Alberta Regional Trials, Peace River Region.
- Figure 6 Yield-Maturity Relationships. 1985 Project Oat Test.
- Figure 7 Yield-Maturity Graph. Canada Western Red Spring Wheat. Alberta Regional Trials, Peace River Region.
- Figure 8 Yield-Maturity Graph. Other Wheats and Triticale. Alberta Regional Trials, Peace River Region.
- Figure 9 Yield-Maturity Graph. Parkland Wheat Co-operative 1987.
- Figure 10 Yield-Maturity Graph. Durum Wheat. Alberta Regional Trials, Peace River Region.
- Figure 11 Yield-Maturity Graph for Canola. Alberta Regional Trials, Peace River Region.
- Figure 12 Yield-Maturity Relationships, Brassica napus 1987-600 Tests.
- Figure 13 Yield-Maturity Relationships, Brassica campestris 1987-300 Tests.
- Figure 14 Yield-Maturity Graph for Flax. Alberta Regional Trials, Peace River Region.

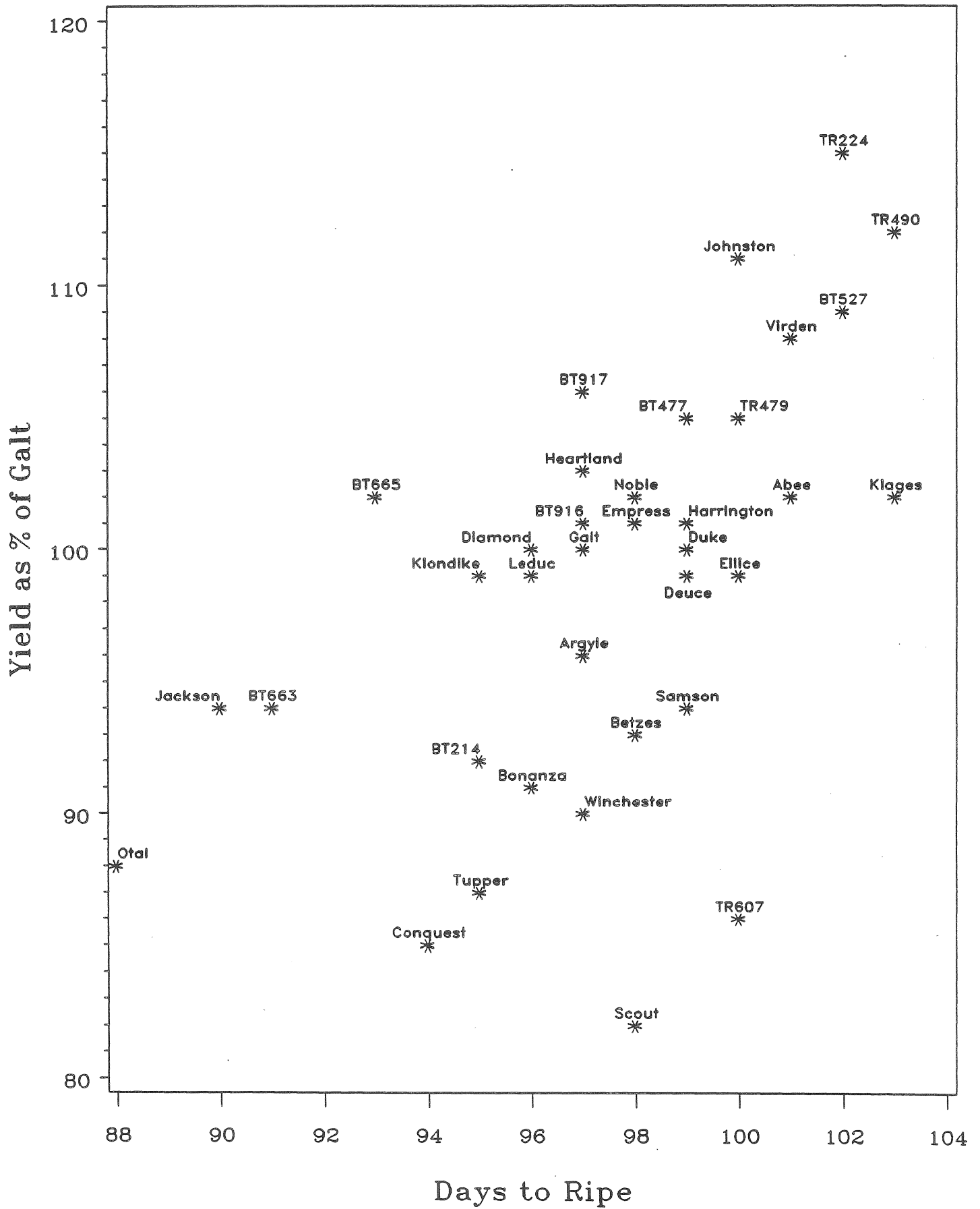
CANADIAN GRAIN EXPORT SYSTEM SYSTÈME D'EXPORTATION DU GRAIN CANADIEN

125



-  Rail
Voie ferrée
-  Lakers
Navires des Grands Lacs
-  Terminal elevators
Silos-éleveurs terminaux
-  Transfer elevators
Silos-éleveurs de transbordement
-  Main production areas
Régions principales de production

Yield-Maturity Graph for Barley



Yield-Maturity Relationships 987 Northwestern Canada Barley Tests

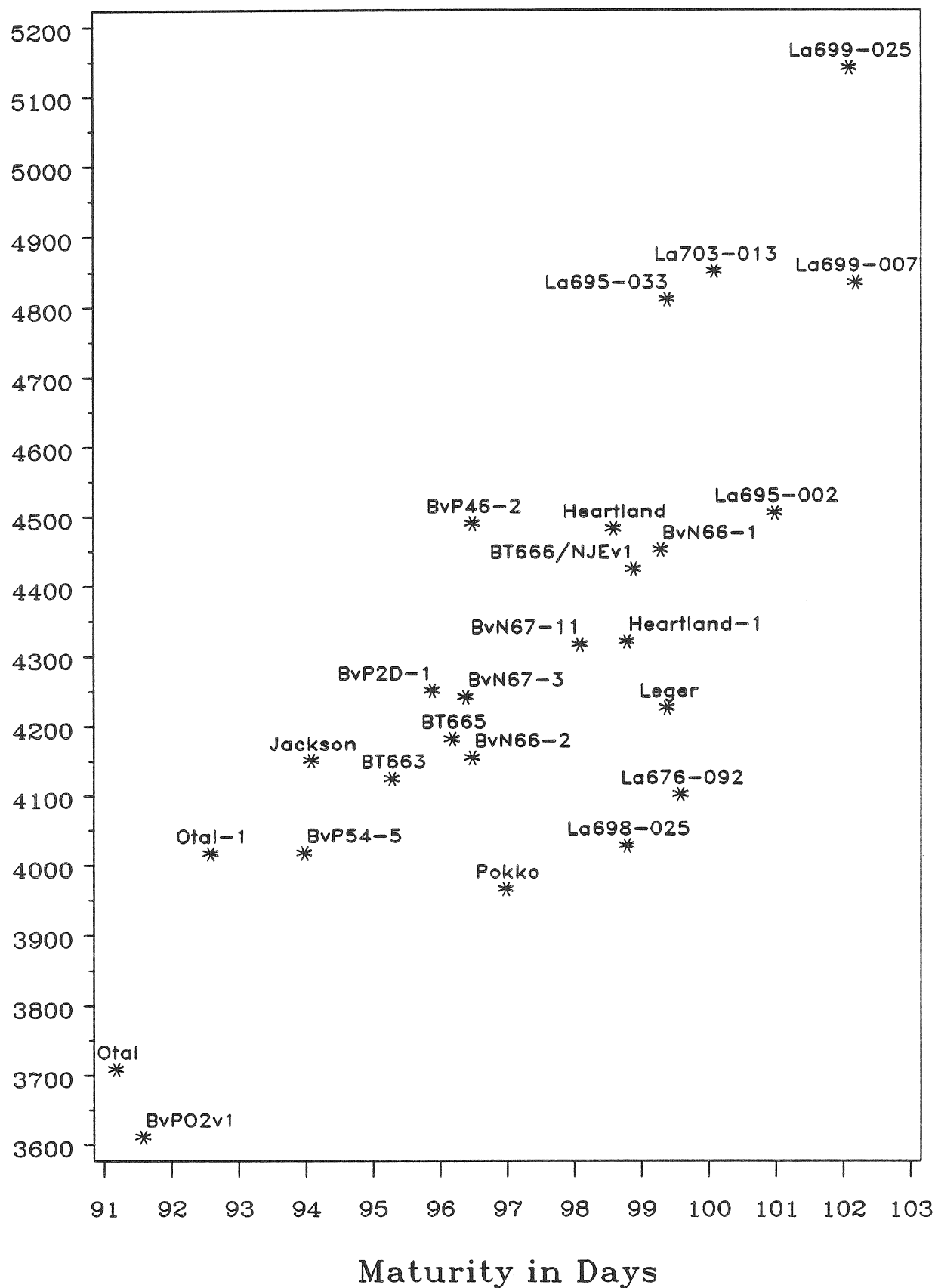
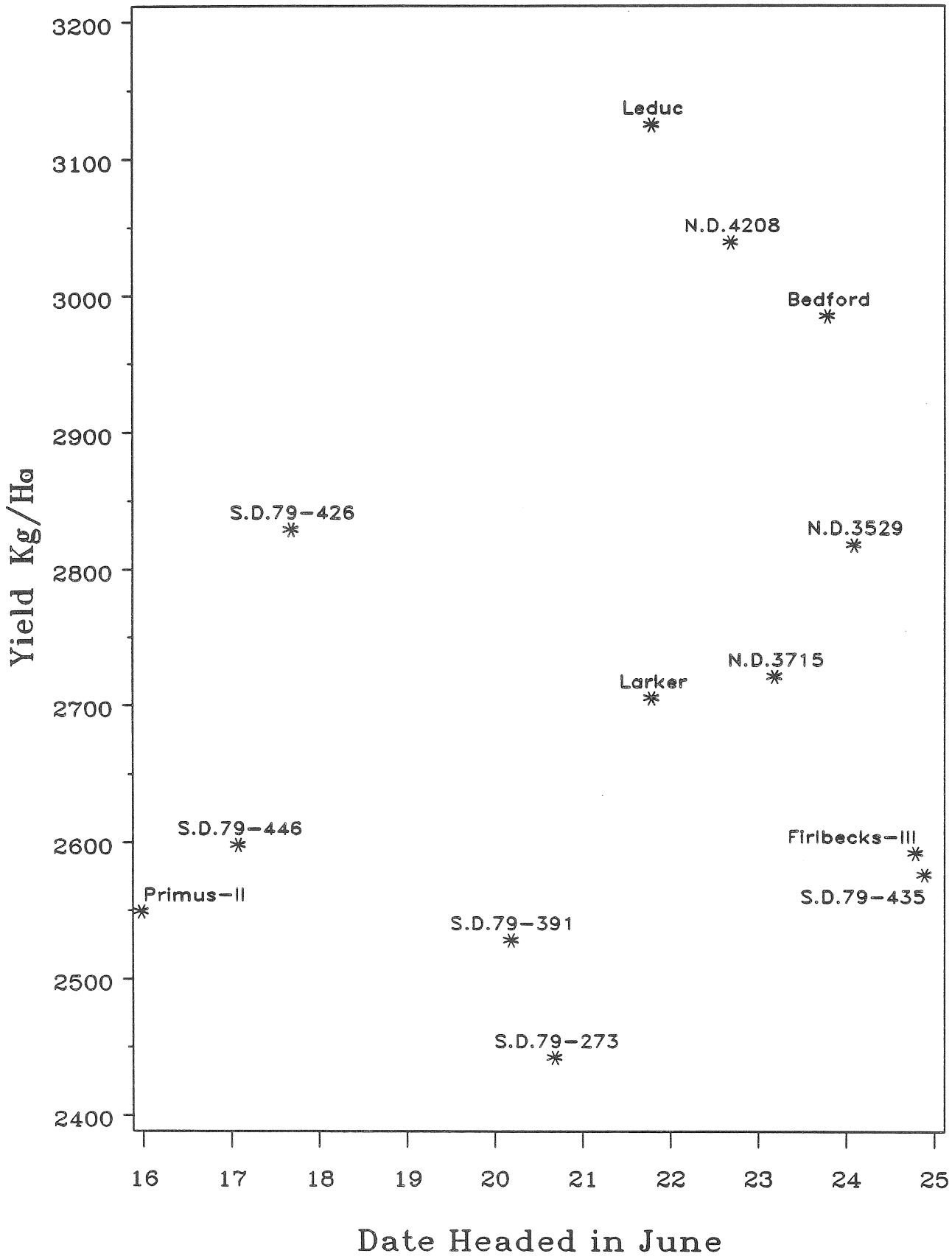
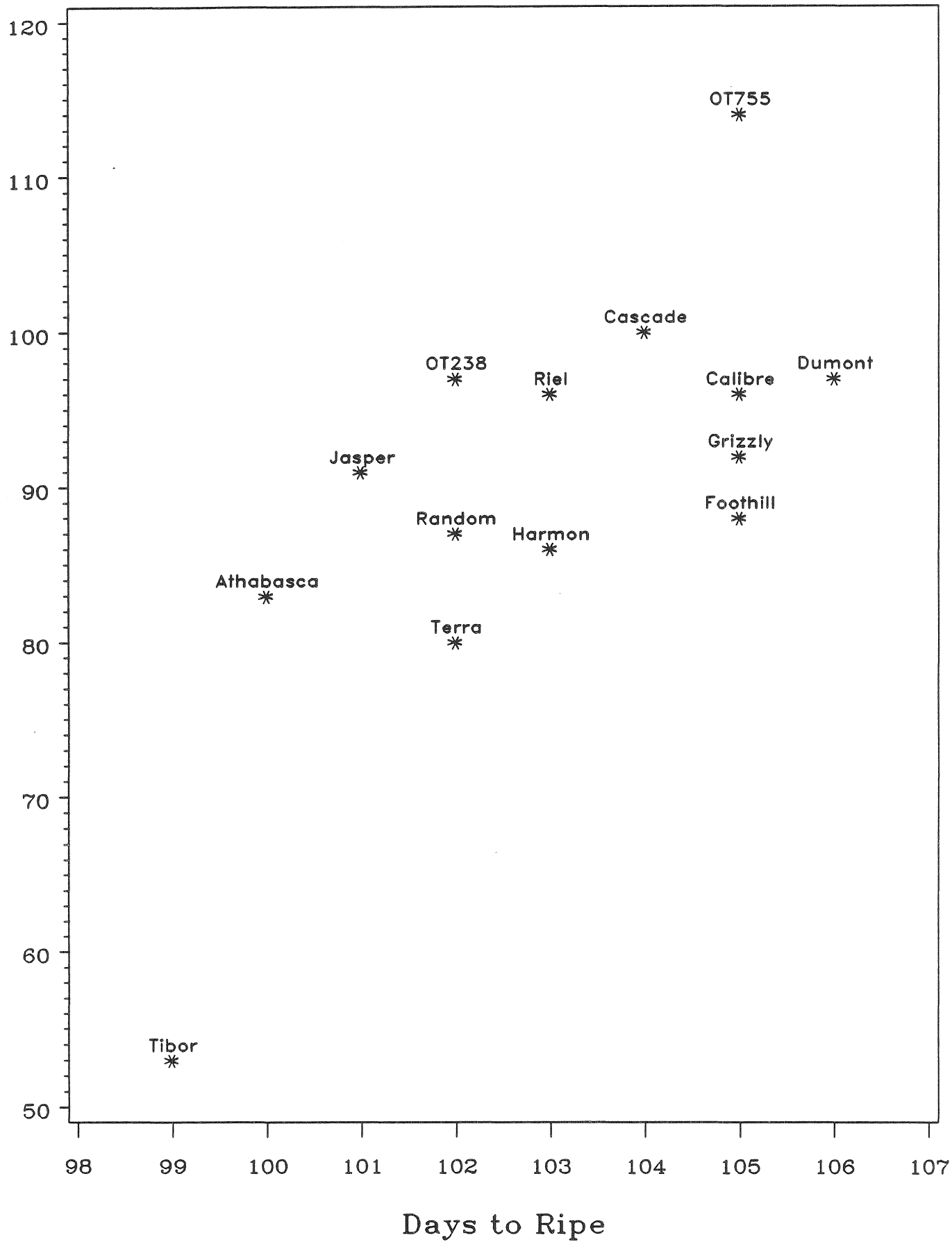


Fig. 4

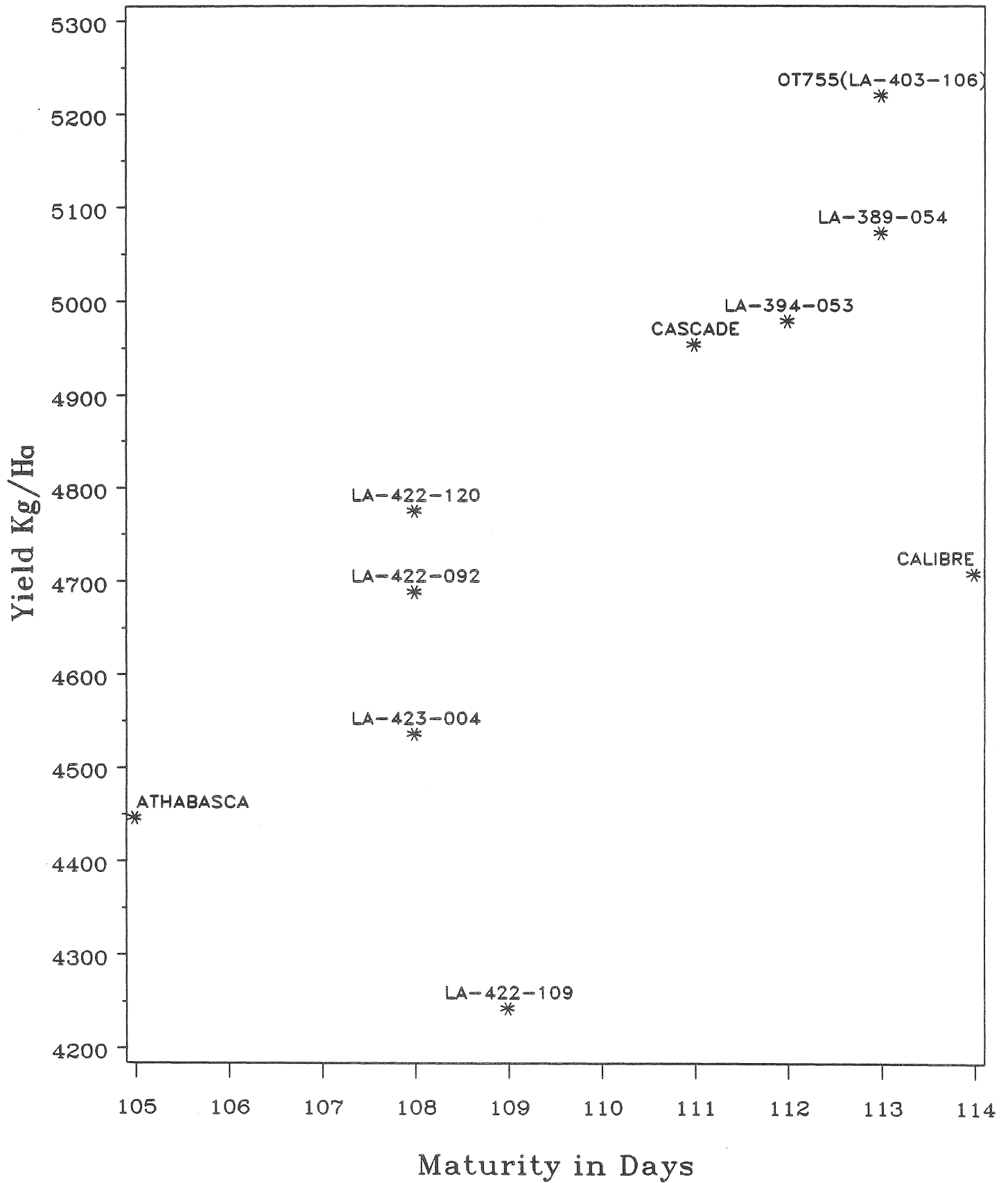
Yield and Date Headed USDA-ARS Great Plains Barley Nursery 198



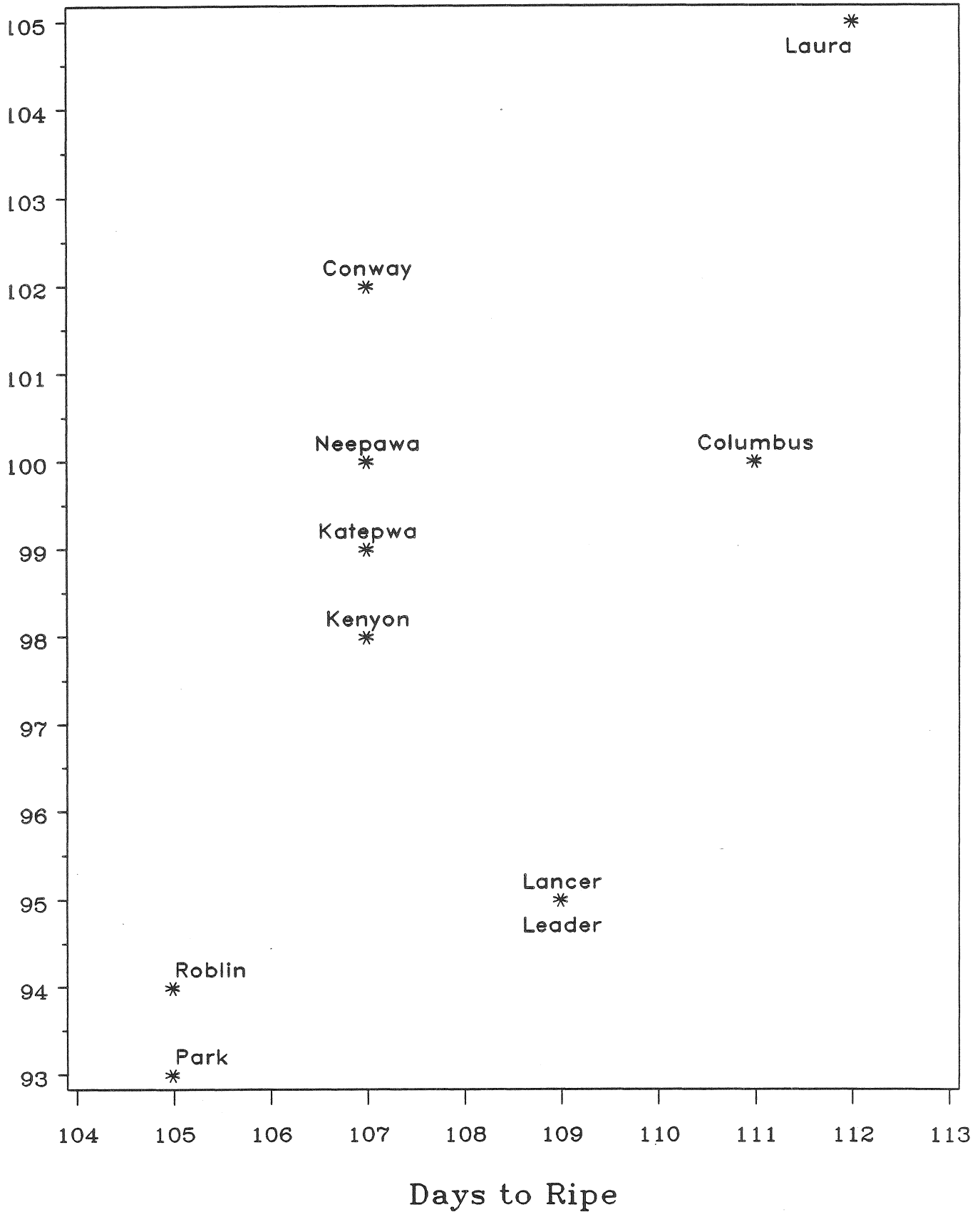
Yield-Maturity Graph for Oats



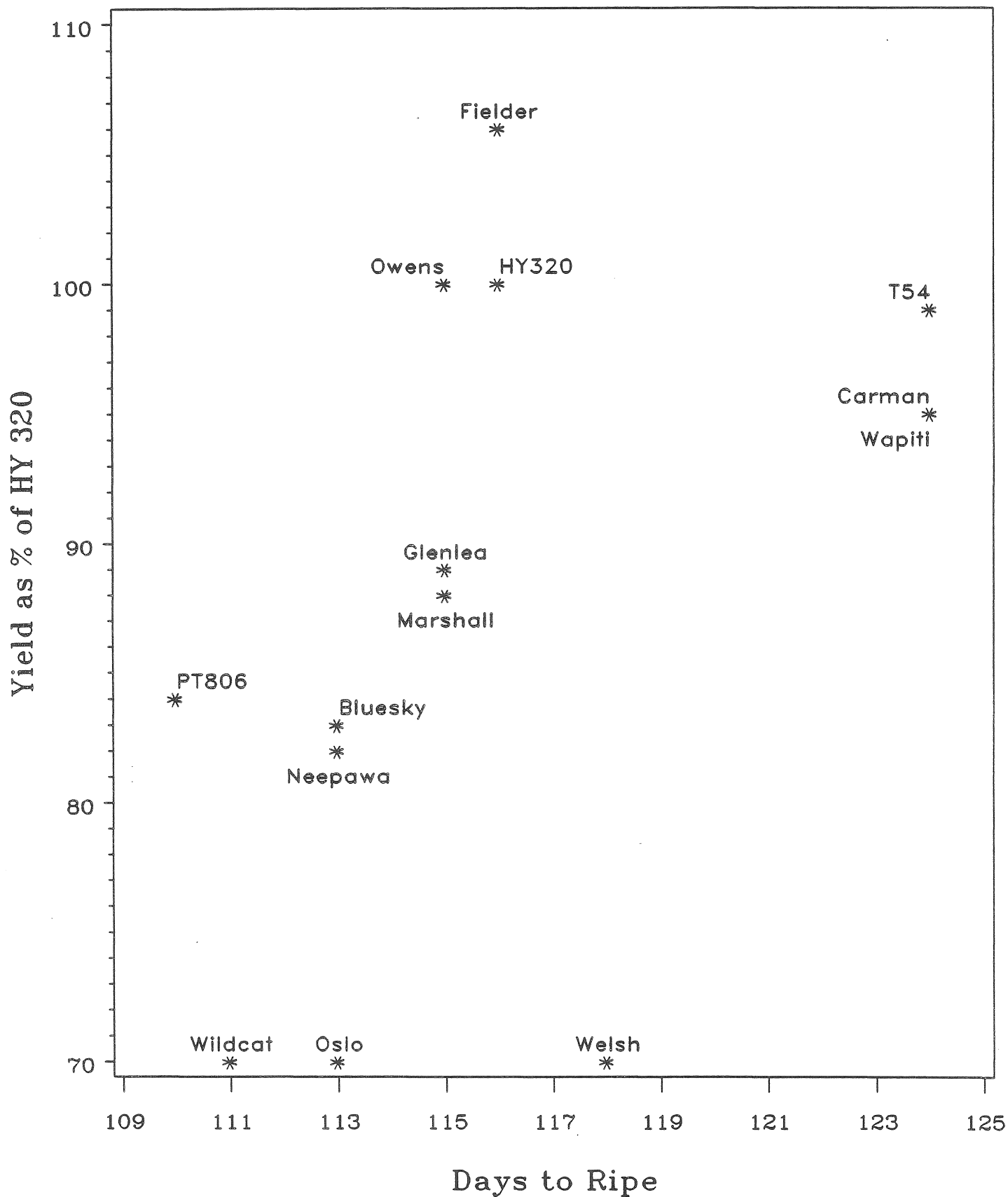
Yield-Maturity Relationships 1985 Project Oat Test



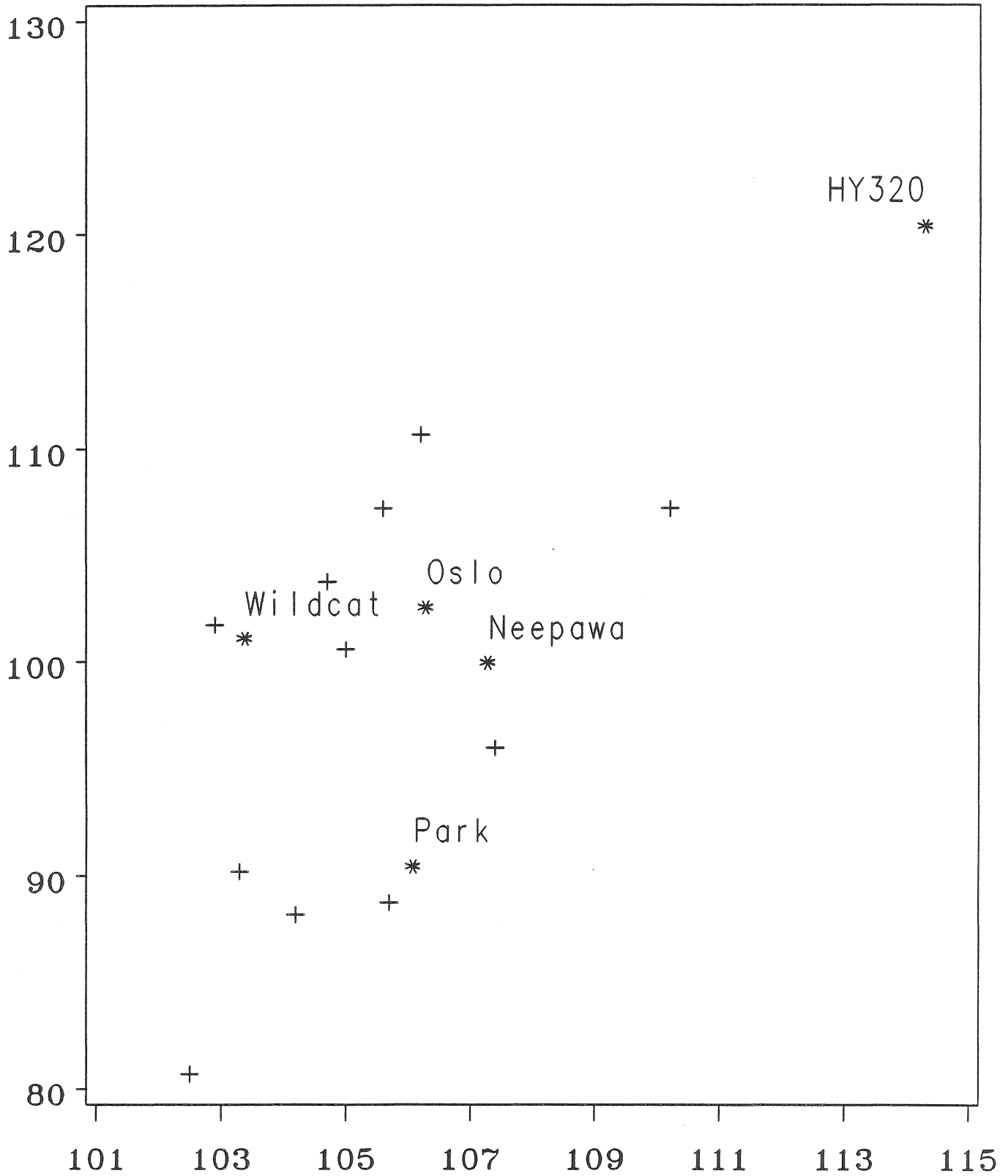
Yield-Maturity Graph Canada Western Red Spring Wheat



Yield-Maturity Graph Other Wheats and Triticale

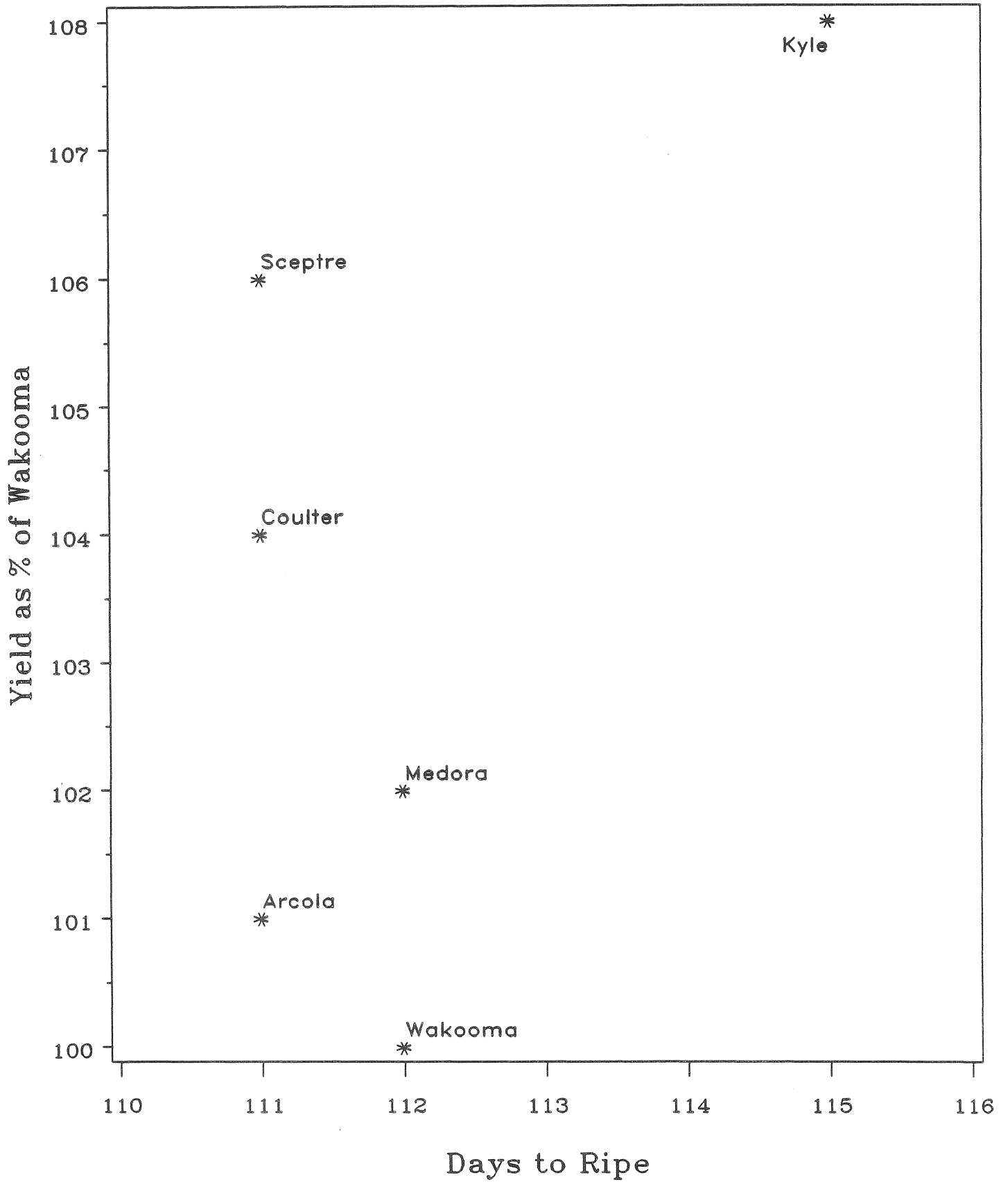


ARKLAND WHEAT CO-OPERATIVE 1987

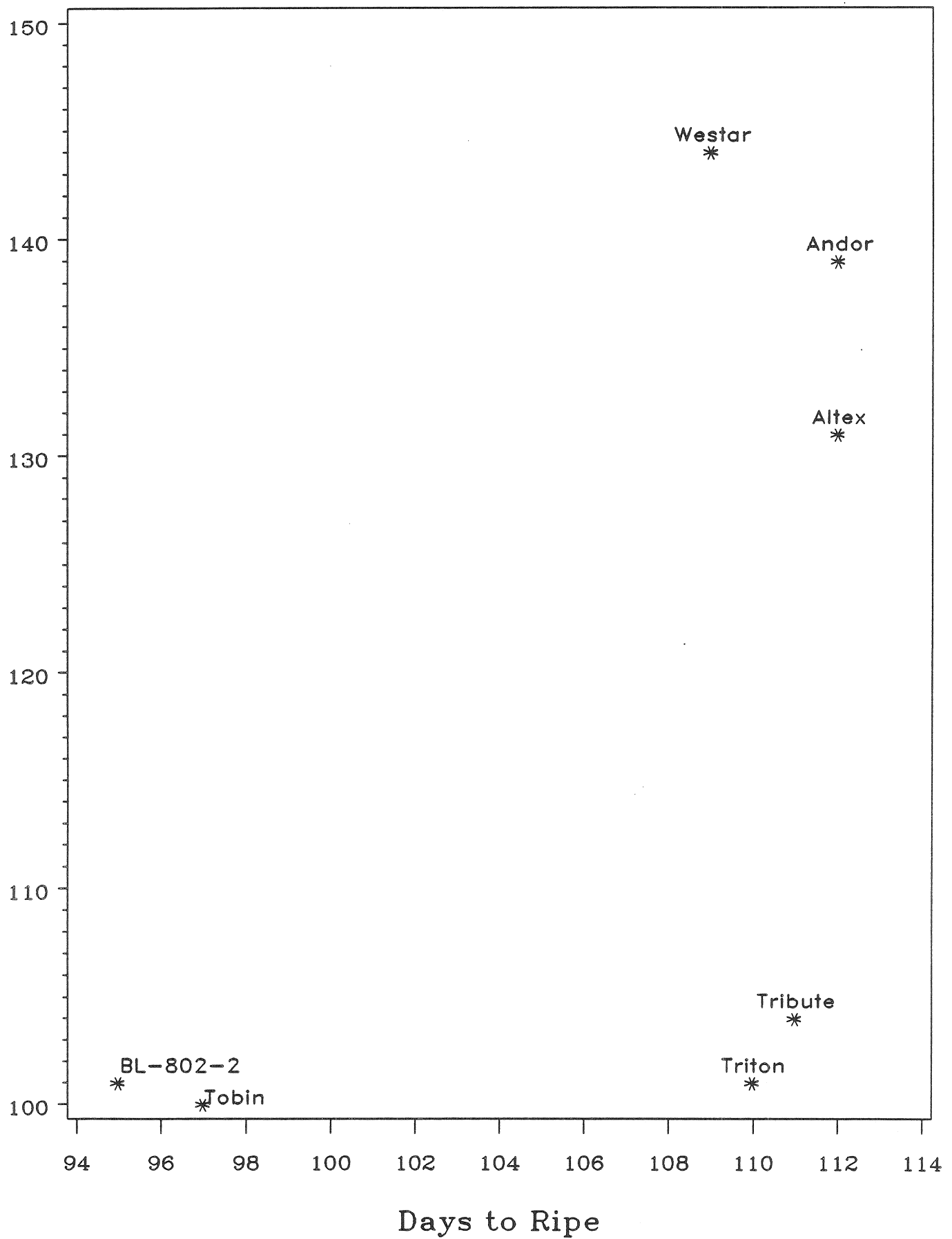


+ + + Co-op Entries * * * Check Cultivars

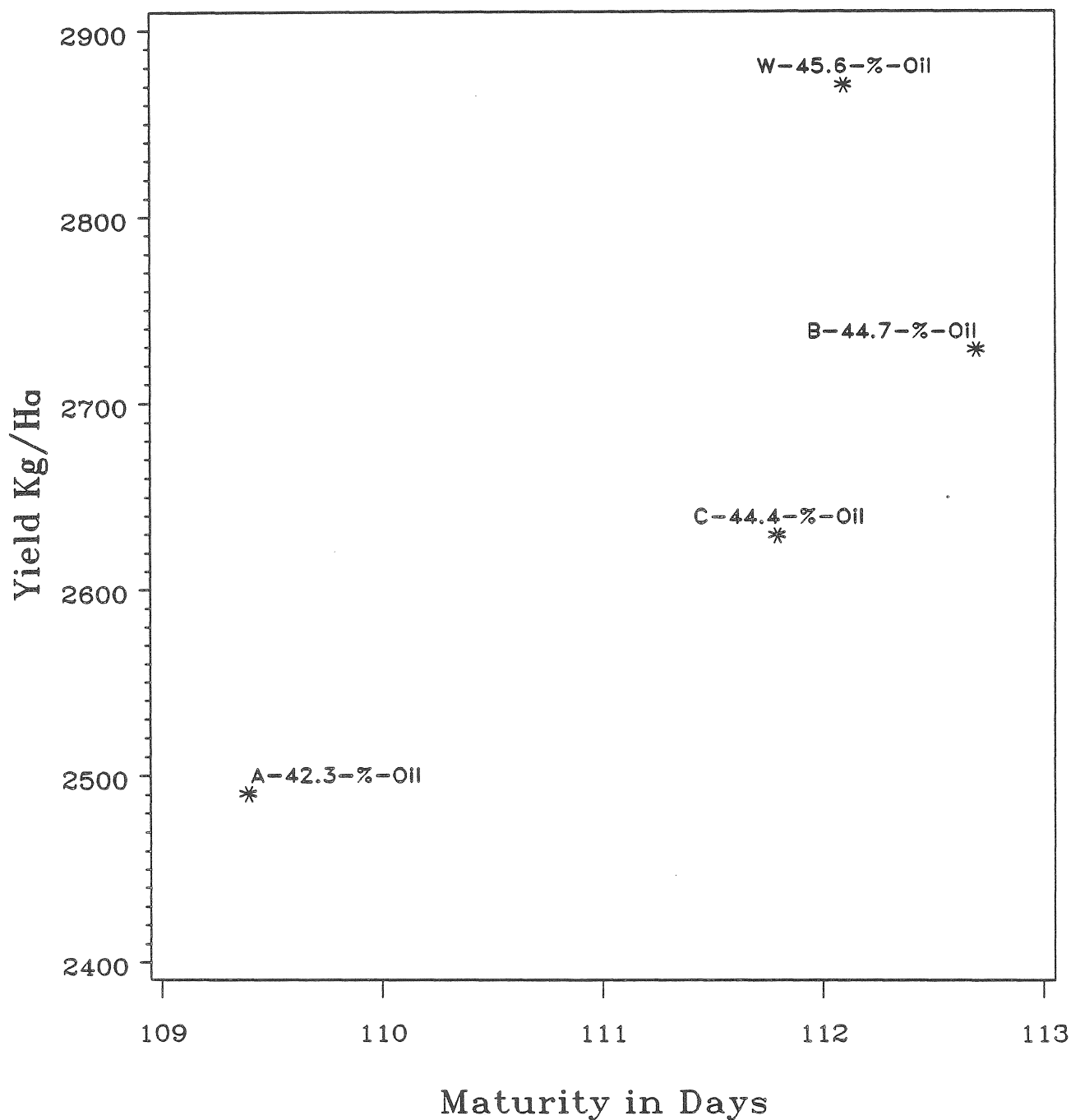
Yield-Maturity Graph Durum Wheat



Yield-Maturity Graph for Canola



Yield-Maturity Relationships Brassica Napus 1987-600 Tests



Yields - 4 locations. Beaverlodge, Fairview, Dawson Creek, Fort Vermilion 4 Reps/Line
 Maturity - 2 locations. Beaverlodge, Fort Vermilion
 Oils - 5 locations. Lethbridge, Beaverlodge, Fairview, Dawson Creek, Fort Vermilion

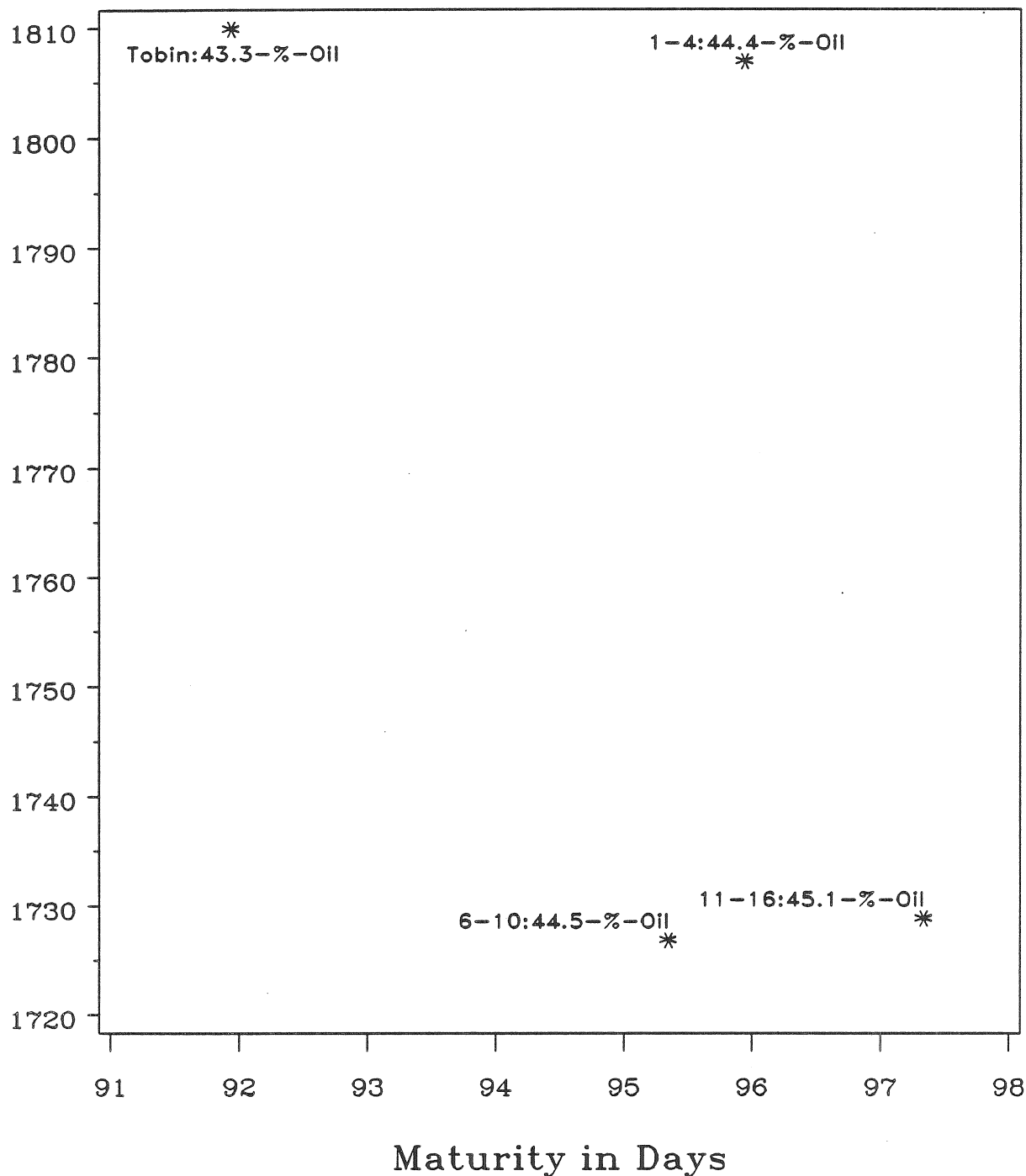
W = Mean of 4 Westar (16 plots per locations).

A = Mean of 10 lines selected for earliness, yield and oil content, from Winter Chinese/Westar Cr.

B = Mean of 7 related lines.

C = Mean of 4 related lines.

Yield-Maturity Relationships Brassica Campestris 1987-300 Tests



s - 5 locations. Lethbridge, Beaverlodge, Fairview, Dawson Creek, Fort Vermilion 4 Reps/Line
 rity - 2 locations. Beaverlodge, Fort Vermilion
 - 5 locations. Lethbridge, Beaverlodge, Fairview, Dawson Creek, Fort Vermilion

Combined data for 4 conventional lines.

) 5 lines. Early maturing subdivision of base population 6-16.

16 6 lines. Late maturing subdivision of base population 6-16.

○ 2 Tobin checks

Yield-Maturity Graph for Flax

