Canola Yield Trends: Cause for Concern or the Price of Expanded Acres.

R.G. Berard and S.A. Brandt
Agriculture and Agri-Food Canada
Saskatoon and Scott, SK

Introduction:

There has been concern expressed by growers and researchers in the past few years regarding declining canola yields in Saskatchewan. A survey of canola growers was conducted by agronomists at Sask Ag and Food in 1995 to determine the extent of the problem and find out which factors were likely responsible for reducing their yields. (S. Brandt, 1996). In some cases, the growers were confident they knew the cause of their yield loss, but in many cases the growers could not point to a single factor responsible for their poor yields. A summary of the factors suspected by the growers of contributing to reduced yields were as follows:

- High temperature at flowering/early seed set
- Disease
- Insect damage
- Excess water/flooding/waterlogging
- Perennial and annual weeds
- Poor early crop vigor
- General poor establishment and growth

The survey generated more questions than answers and prompted a concerted effort to investigate the canola yield decline issue and develop recommendations based on the findings. The objective of this paper is to ask some simple questions in order to generate some thoughts and hypotheses regarding the problem of declining canola yields.

Is there really a yield decline problem?

It is important at the outset to clearly establish whether there is in fact a problem of declining canola yields in Saskatchewan based on hard evidence; ie. on actual production records. Figure 1 shows average canola yields in Saskatchewan from 1960 to 1998 (Source: Sask Ag and Food, Agricultural Statistics). The historical yield data appear to be grouped into 3 distinct periods. The "rapeseed" era in the 60's and early 70's is characterized by fairly uniform yields averaging around 18 bu/ac. In the mid-seventies there is a dramatic increase, coinciding with the advent of canola, to a higher yield level averaging 23.4 bu/ac. This period is characterized by more erratic yields with a couple of notable poor years in 1979 and 1984. In 1988, Saskatchewan suffered through a major drought which resulted in a significant decrease in yield. In 1990, canola yields had recovered from this drought but to a new plateau which was 5% lower than prior to the drought (except for one good year in 1996). There is no explanation for this lower yield plateau in the 90's but it appears to substantiate the claim that canola yields are on the decline.

If we compare canola's performance relative to other major crops in Saskatchewan (Figure 2) by looking at their respective trend-lines, we find that the yield trend for barley and flax are far superior to that of canola with steady increases throughout the 1960-98 period. The wheat trend-line is not as strong as barley or flax and would appear to be headed for a maximum in 1999. On the other hand, the canola yield trend reaches a maximum in 199 1 and has been on the decline since then. Despite the uncertainty of these trend-lines due to the high variability in yields, they do serve to illustrate the fact that canola yields have not kept pace with the progress exhibited by other major crops in the 90's. A comparison among the 3 prairie provinces of average canola yields in the last 4 decades (data not shown) suggests that Saskatchewan yields have fallen behind in the 90's (15.5% behind Manitoba and 6.7 % behind Alberta). In the search for answers as to why Saskatchewan canola yields are declining, it may be useful to compare data between provinces to determine whether different cultural practices or other factors might explain the differences in yield.

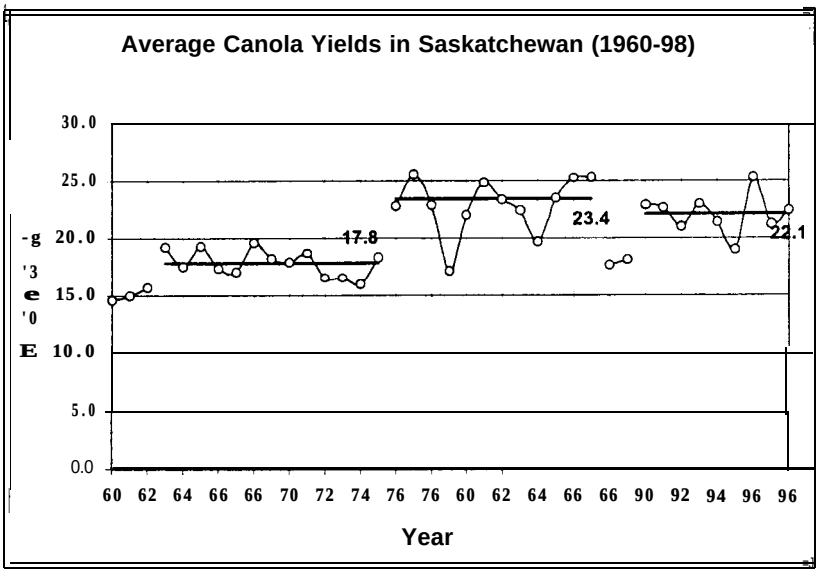

Figure 1. Average Canola Yields in Saskatchewan (1960-98)

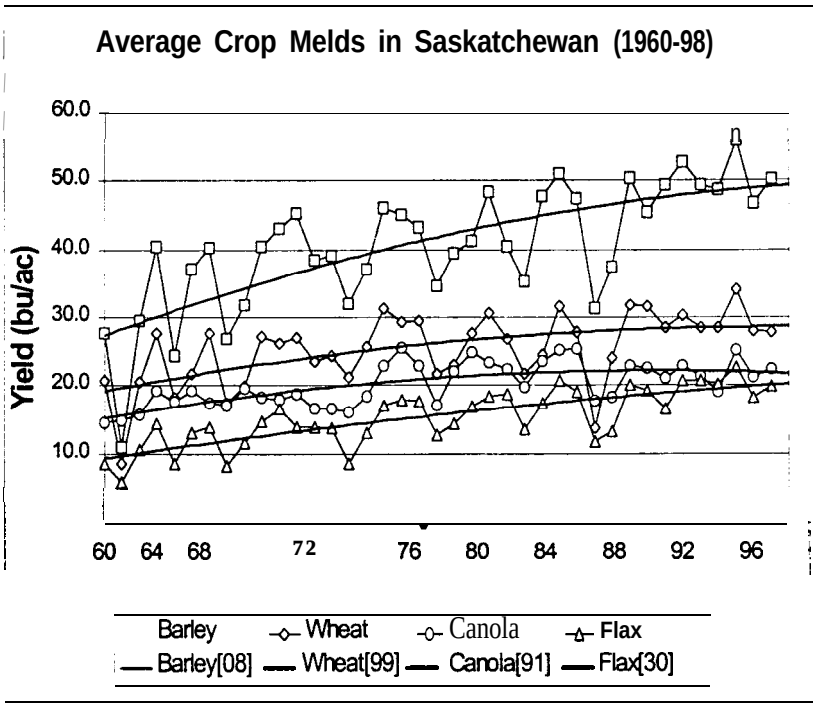

Figure 2. Average crop yields and fitted trend lines for 4 major crops in Saskatchewan from 1960 to 1996.

Is the problem general or localized?

An analysis of the distribution of canola production and associated yield throughout the province

of Saskatchewan over the last two decades can be useful in determining where the problem areas are and what site specific factors might be at the root of the problem. Figure 3 illustrates the expansion of canola production in the last 19 years. Relatively large increases in acreage have occurred in crop districts 1,5,6 and 7 whereas crop districts 8 and 9a have experienced moderate increases and 9b acres have remained virtually unchanged. The corresponding changes in average yield over the last 5 year period relative to a 10 year period just prior to the 1988 drought is displayed in Figure 4. We can see that yields in crop districts 7b, 9a & 9b have declined from 1% to 16% whereas crop districts la&b, 6a, 7a and 8a had yield increases ranging from 2.5% to 17%. The question that needs to be asked is why are certain areas experiencing yield increases while others are seeing declining yields ?

One might hypothesize that yields in traditionally high production areas like crop district 9a & 9b are declining due to increased disease pressure brought about by a long history of high production. Other high production areas like 5a, 5b, and 6a may not have experienced similar yield declines because their production histories indicate that the increase in canola acreage in those districts is relatively recent, resulting in a potentially lower disease pressure. However, this would not be consistent with the yield decline in crop district 7b, which has seen only recent increases in production. Such a yield decline in a relatively new area may be due to expansion into areas not suitable for canola or to poor management practices by inexperienced growers. These are only speculations and further investigations on the cropping histories and rotational practices may reveal some important insights into the variable yields among different crop districts.

What do we know about growers' cultural practices?

A recent Saskatchewan Crop Insurance Corporation program called Management Plus Program (MMP) is providing valuable information regarding grower practices which may help to explain canola yield trends. The MMP program asks growers to provide information on a wide range of cultural practices including seeding practices (equipment, rates and dates of seeding, cultivars, etc.), seeding into stubble vs fallow, harvest dates, etc. With total participation representing over 5% of canola acreage across all crop districts in 1998, this information can provide valuable information on farm practices which may impact on yields.

Regarding the issue of growing canola on stubble vs fallow, Figure 5 illustrates the growing trend towards less summer-fallowing in favor of planting canola into stubble, particularly in areas like 9a, 9b and 5b where 80% of canola was planted on stubble in 1998. Could this be a factor causing yield decline in those areas? The corresponding yield data from the MPP program (Figure 6) does not provide any clear evidence for the advantage of fallow over stubble or vice versa. There is a trend for improved yields on fallow in crop districts 6a&b, 7a&b, and 9b, no effect in 5a&b and 9a, and the reverse effect in 8a&b. More research is required to determine how important this factor is in canola production and to what extent any negative effects can be compensated by other practices such as fertilization and weed control.

If we now consider canola varieties as a possible factor affecting yield trends, the MMP data reveals an interesting trend in grower preference regarding herbicide tolerant (HT) vs conventional varieties. Figure 7 illustrates a significant shift from conventional to HT varieties in the past 3 years, from a mere 7% of HT acreage in 1996 to 50% in 1998. The corresponding yield data did not show any yield differences between HT and conventional varieties, but the question

remains as to how this new technology might be used or misused to the detriment of crop yields. For example, with HT varieties, growers may be tempted to delay spraying until most weeds have emerged in order to get the most for their chemical buck. However, work by Harker (1999) has demonstrated that delaying weed control has a very negative impact on yields. There is also a concern that HT varieties may not be as resistant to diseases.

One of the factors of most concern to growers (as expressed in the 95 survey) is that of high temperature stress from flowering to seed filling. The most common complaint from growers was that their canola crops looked very healthy with good pod development and the potential for a bumper crop but the harvest would result in only a fraction of anticipated yields, with many small and shriveled seeds. It appears that their crop may have suffered excessive heat or drought stress at the critical stage of pod development and seed filling. A brief look at yield data and associated mean maximum July daily temperatures (Figure 8) revealed that there are in fact some clear associations with temperature extremes during the flowering/pod development stages and final yields. It may be important to investigate this problem in more depth to determine how important it is in undermining crop yields. While it is not possible to control weather, it may be necessary to direct our efforts towards shifting the sensitive growth stages away from the high temperature periods, either through genetic manipulation or cultural practices (fall or early spring seeding).

Summary: where do we go from here?

In summary, it is evident from actual production data that the recent decline in canola yields is real. An examination of crop district data suggests that the problem may be localized in areas of traditionally high production such as crop districts 9a&b although there are anomalies to this trend. Further work may need to focus on cropping histories in individual crop districts to determine if problems such as shortened rotations or long histories of canola production may be increasing disease pressure in these areas. Changes in cultural practices such as stubble vs fallow and the use of HT varieties should also be studied to determine their potential effects on crop yields. An extensive analysis of climatic factors, in particular high temperature stress during critical developmental stages, should be undertaken to determine the impact of such environmental conditions on crop development and yield.

References:

Brandt, S.A. 1996. Canola yield-loss survey provides more questions than answers. Canola Guide. Dee 96 / Jan 97, p. 36-37.

Harker, N. 1999. Integrated Canola Management for a “Top Bottom Line”. Paper presented at Canola Days 1999 Annual Meeting, Jan.14, 1999, Saskatoon, SK.

Saskatchewan Agriculture and Food, Statistics Branch, 3085 Albert Street, Regina, SK, S4S OBl, Phone (306) 787-5951. Contact: Dale Sikora.

Management Plus Program, Saskatchewan Crop Insurance Corporation, Box 3000, Melville, SK, SOA 2P0, ph. (306) 7287240. Contact: Keith Hayward

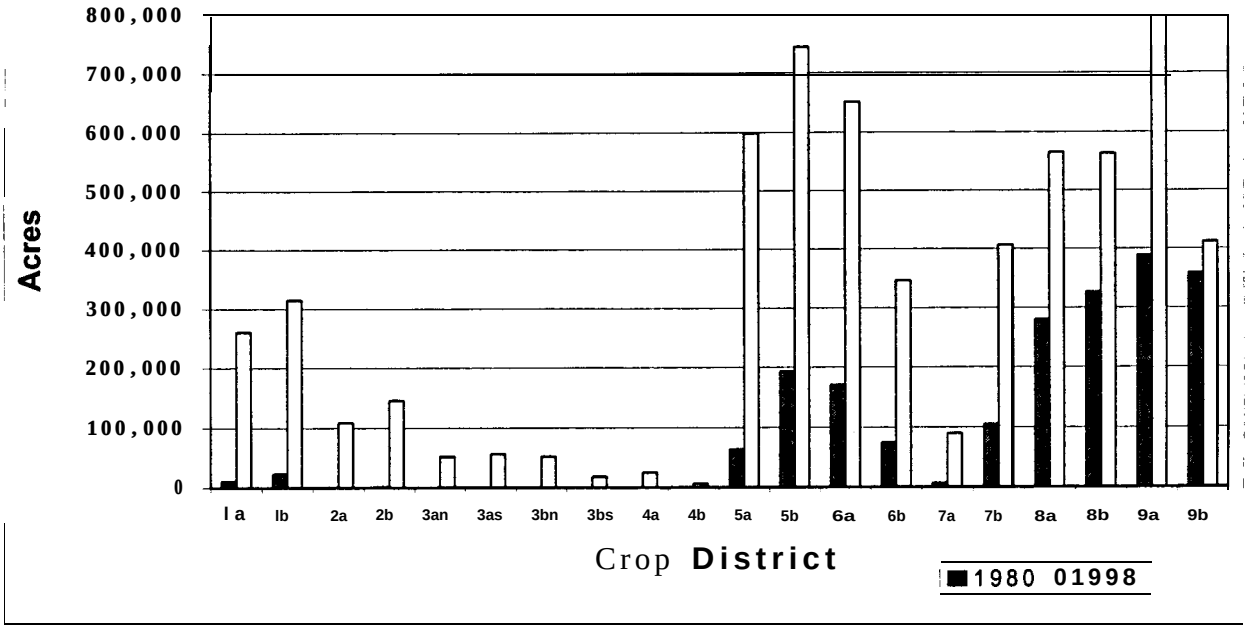

Figure 3. Canola acreage in all crop districts of Saskatchewan in 1980 and 1998.

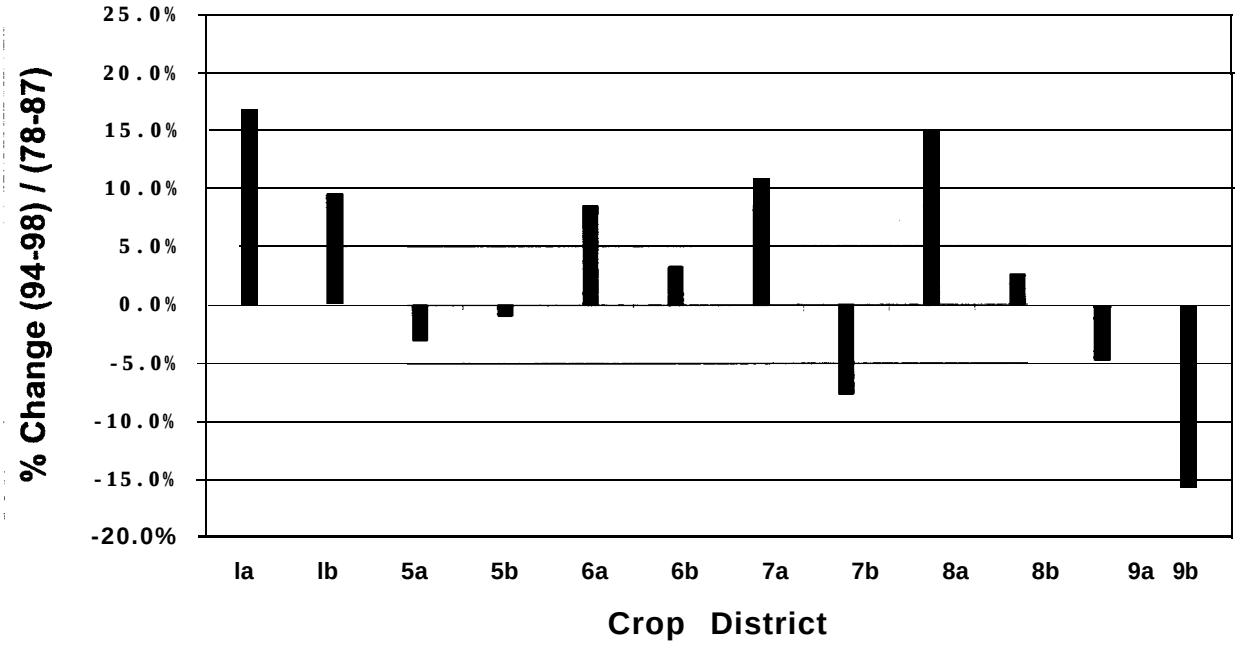

Figure 4. Change in average canola yields for the last 5 years (1994-98) relative to a 1 **0-yr** period (1978-87) in the main canola growing crop districts of Saskatchewan.

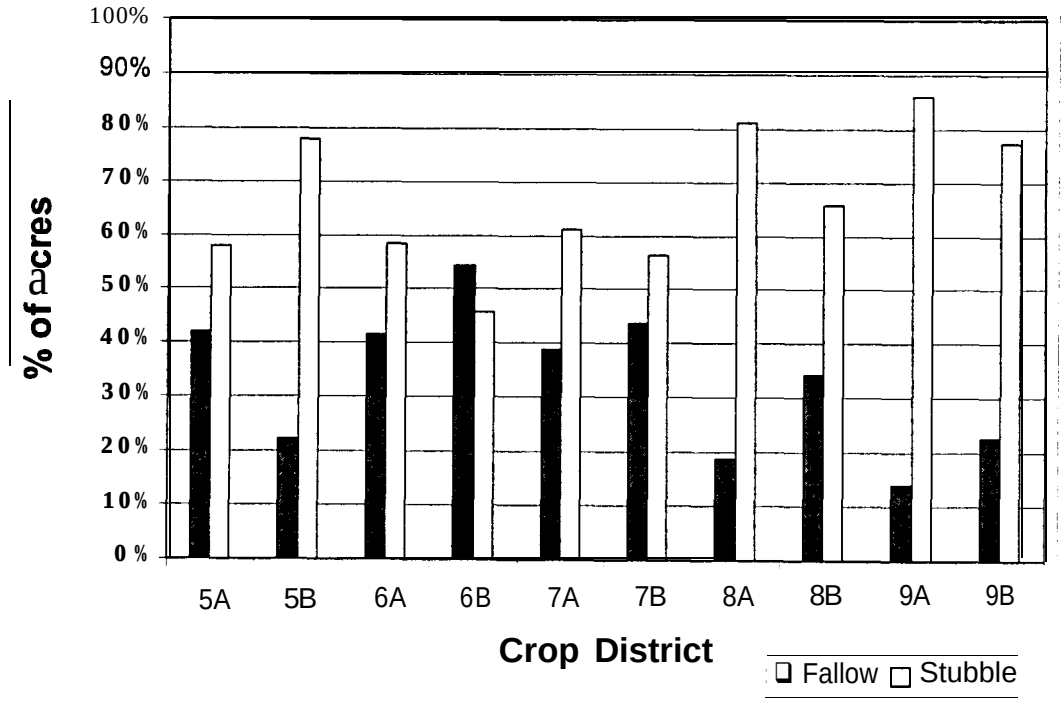

Figure 5. Percent of canola acreage grown on fallow vs stubble in 1998.

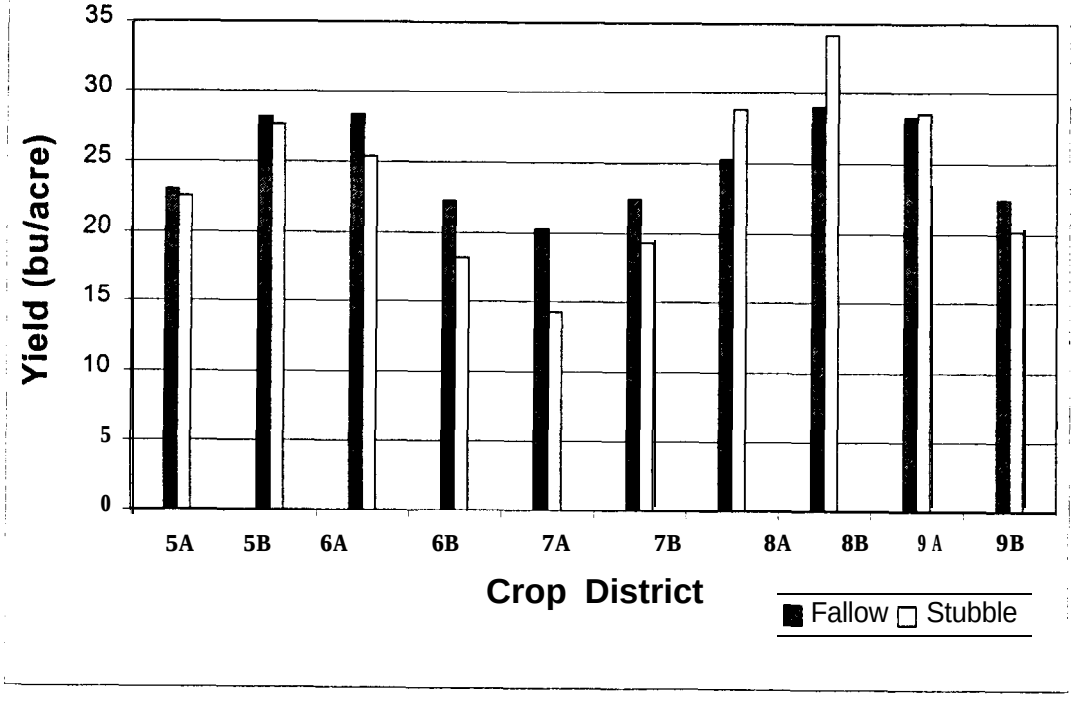

Figure 6. Canola yields on fallow vs stubble in 1998.

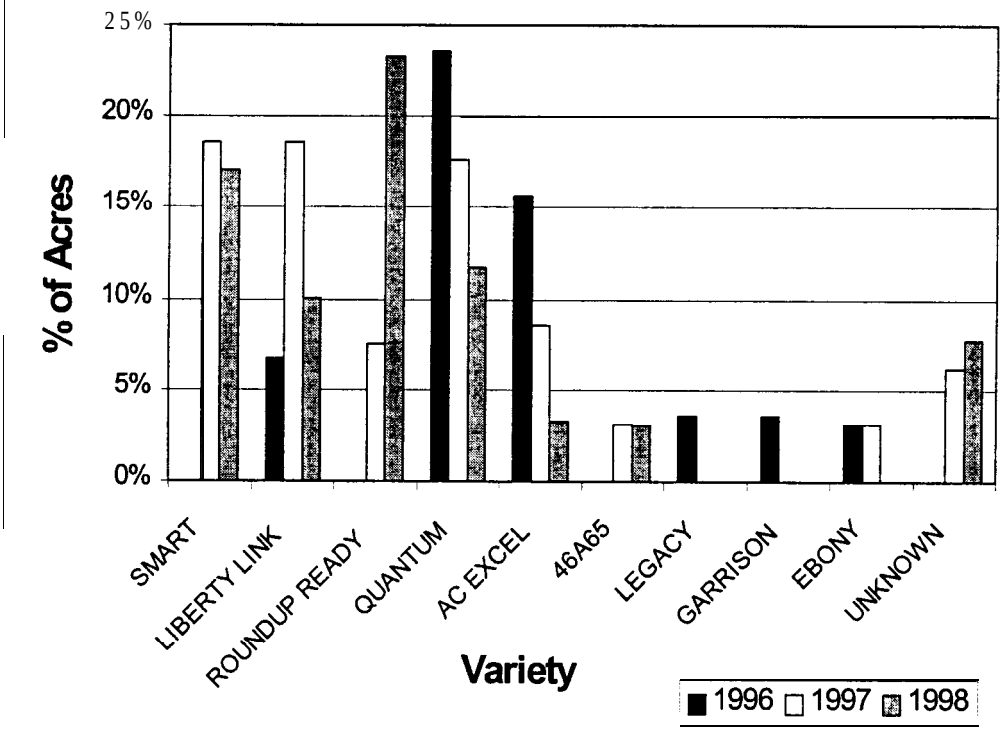

Figure 7. Most common canola varieties grown in Saskatchewan from 1996 to 1998.

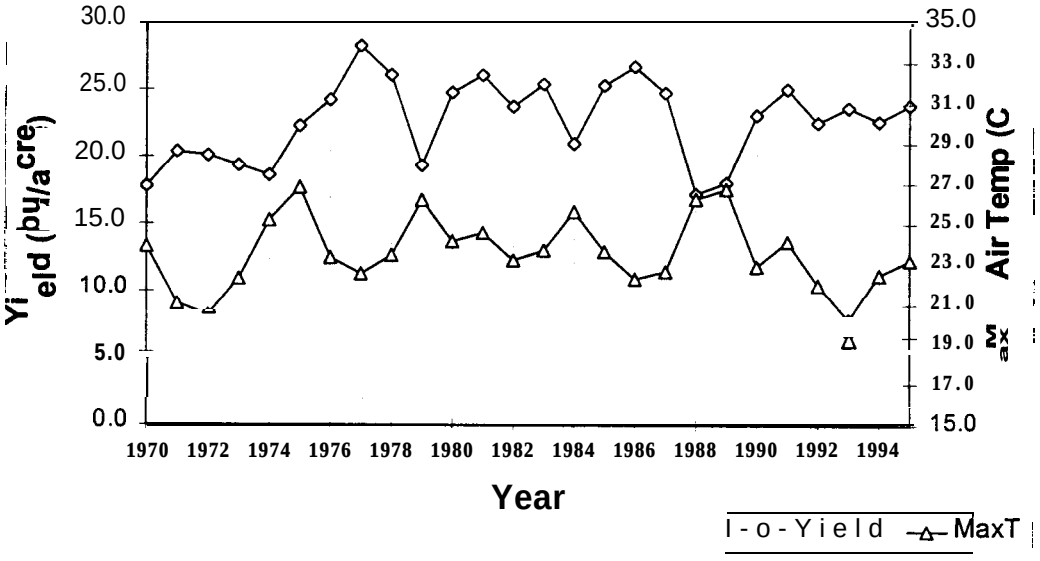

Figure 8. Mean maximum temperatures in July and canola yields in Crop District 8b.