AN ABSTRACT OF THE THESIS OF

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Title : Effects of Harvest Dates on Sweet Corn Maturity, Sugar Content and Yield.

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Studies were conducted in 1976 and 1977 on the effects of harvest dates on maturity, yields and sugar content of four cultivars of sweet corn. The cultivars were 'Golden Cross Bantam', 'Jubilee', ' Rapidpak' and ' Tendertreat'. Moisture content of kernels ranged from 80 to 67 per cent for the six harvest dates.

A regression technique was used to estimate relationships of yield, percent moisture in kernels and sugar content to the six harvest dates. Relationships of yield and sugar content to percent moisture content in kernels were also estimated.

Yield of husked, acceptable (good) ears, which was used as a standard of yield estimation, was increased by a delay in harvest. The increase averaged 0.135 tons per acre for each day's delay in harvest for three cultivars in 1976 and 0.152 tons per acre per day in 1977. No evidence of linear or quadratic relationships between yield and harvest date were found for 'Tendertreat'.

Kernel moisture loss was highly correlated with harvest date and

degree hours. Kernel moisture loss averaged 0.687 per cent for each day's delay in harvest in 1976 and 0.577 per cent per day in 1977. Yield increases averaged 0.173 tons per acre for each one percent drop in moisture content of kernels for three cultivars in 1976 and 0.264 tons per acre percent moisture drop of kernels in 1977.

Quantitative analysis of sugar content in kernel samples that had been frozen was made by using a gas chromatography technique. Total sugar and sucrose contents dropped most rapidly at early harvests , then decreased slowly. Average rate of sucrose decline was 0.579 per cent for each day of delay of harvest in 1976 and 0.226 per cent per day in 1977. Total sugar decreases averaged 0.589 per cent for each one percent drop in moisture content of kernels in 1976 and 0.304 per cent with each per cent moisture drop of kernels in 1977. Reducing sugar decreased rapidly as harvest was delayed and fructose decreased faster than glucose. There were differences in cultivars in initial sugar content and rapidity of loss as maturity progressed. It appears that a 1:10 ratio of fructose to sucrose may be related to good quality of kernels.

The use of the accumulated heat unit system for predicting optimum maturity showed no increase in precision over the use of the number of days from planting to harvest.

Proper timing of harvest and selection of cultivars need to be made, as well as giving consideration to other factors, to achieve optimum yields and sugar content of sweet corn.

Effects of Harvest Date on Sweet Corn Maturity, Sugar Content and Yield

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TABLE OF CONTENTS

I. Introduction 1

II. Literature Review 3
Factors Affecting Maturation
Rate 3
Factors Affecting Yield 5
Methods for Determining Maturity 6

III. Materials and Methods 10

IV. Results and Discussion 14
Time and Rate of Silking 14
Yields 17
Relationship between Yields and
Harvest Dates or Degree Hours 17
Moisture 24
Relationship between Percent
Moisture and Harvest Dates or
Degree Hours 27
Sugar Concentration 34
Changes in Sugar Concentration 38
Relationships of Yield and
Sugar concentration to Percent
Moisture content in Kernels 48

V. Summary and Conclusions 56

VI. Literature Cited 59

Appendices 63

(continued)

Figure		Page
14	Sucrose concentration as % of dry weight in sweet corn kernels of four cultivars at different harvest dates in 1976	41
15	Sucrose concentration as % of dry weight in sweet corn kernels of four cultivars at different harvest dates in 1977	41
16	Regression of total sugar concentration in kernels on harvest date adjusted to Jub at 5 % total sugar in 1976	44
17	Regression of total sugar concentration in kernels on harvest date adjusted to Jub at 5 % total sugar in 1977	45
18	Regression of sucrose concentration in kernels on harvest date adjusted to Jub at 5 % sucrose concentration in 1976	46
19	Regression of sucrose concentration in kernels on harvest date adjusted to Jub at 5 % sucrose concentration in 1977	47
20	Regression of yield on percent moisture content in kernels in 1976, curves adjusted to Jub at 72 % moisture	50
21	Regression of yield on percent moisture content in kernels in 1977, curves adjusted to Jub at 72 % moisture	51
22	Regression of total sugar on per cent moisture content in kernels, curves adjusted to Jub at 72 % moisture in 1976	52
23	Regression of total sugar on per cent moisture content in kernels, curves adjusted to Jub at 72 % moisture in 1977	53

LIST OF TABLES

Table		Page
1	Days and degree hours required from planting to silking for four cultivars	16
2	Days and degree hours for various growth stages of sweet corn cultivars in 1976 and 1977	18
3	Yield data for 1976 at six harvest dates	19
4	Yield data for 1977 at six harvest dates	20
5	Regressions of yield on days and on degree hours from planting to harvest for each cultivar	23
6	Regressions of percent moisture in kernels on days from planting to harvest and on degree hours from planting to harvest, 1976 and 1977	31
7	Sugar analyses for four cultivars of sweet corn sampled at six harvest dates, 1976	35
8	Sugar analyses for four cultivars of sweet corn sampled at six harvest dates, 1977	37
9	Regressions of total sugar concentration in kernels on days and on degree hours, 1976 and 1977	42
10	Regressions of percent sucrose concentration in kernels on days and on degree hours, 1976 and 1977	43
11	Regressions of yield and total sugar concentration of kernels against moisture content of kernels for four cultivars of sweet corn, 1976 and 1977	49
12	Adjustment of yield and total sugar from the moisture content	54

LIST OF APPENDIX TABLES

Table		Page
1	Cull yields and number of culls for four cultivars in 1976 and 1977	64
2	Estimated yields of husked good ears for four cultivars at six harvest dates and average increase for each day of delay of harvest in 1976 and 1977	65
3	Estimated values of moisture content in kernels for four cultivars at six harvest dates and moisture loss for each day's delay of harvest in 1976 and 1977	66
4	Percent moisture content of kernels estimated from the degree hours and average loss per degree hour for four cultivars in 1976 and 1977	67
5	Estimated values of total sugar concentration for four cultivars at six harvest dates and average decrease per day's delay of harvest in 1976 and 1977	68
6	Estimated values of sucrose concentration for four cultivars at six harvest dates and average decline per day's delay of harvest in 1976 and 1977	69
7	Estimated values of yield for four cultivars at different moisture content of kernels and average increase for each one percent moisture drop in 1976 and 1977	70
8	Total sugar concentration estimated from the moisture content of kernels and average decline for each one percent drop in moisture content of kernels for four cultivars in 1976 and 1977	71
9	Determinations of moisture content of sweet corn from frozen samples using different methods for four cultivars in 1976 and 1977	72
10	Estimate of relations among some attributes of sweet corn	73

Effects of Harvest Dates on Sweet Corn Maturity, Sugar Content and Yield

I. INTRODUCTION

The determination of optimum time of harvest for sweet corn has been a problem facing growers and processors. In general, the yield per unit area is of prime importance to the grower, but not as important to the processor. The processor is concerned with three main characters which influence choice of a cultivar : (1) quality; (2) cutting percentage or cut-off; and (3) yield. The determination of optimum harvest thus must be suited to the grower because of good yielding ability and to the processor because of good quality and high recovery or case pack. Growers and processors both desire maximum economic returns. During the maturing process sweet corn changes in yield, moisture content, and chemical composition; these changes are especially important between about 68 per cent and 78 per cent moisture content of kernels. As sweet corn matures during this range of moisture content, the yield usually increases. Later maturity usually results in a corresponding decrease in quality depending upon the mois -ture content. Sweet corn for fresh market or processing is usually harvested when kernel moisture ranges from about 68 to 75 per cent. It is important to know how much of an increase in yield occurs and how much of a decrease in quality results during the period of relatively rapid maturation. Temperatures and cultivars are two important factors related to maturation, along with other factors. The purpose of this investigation was to study the changes of yield and quality of four cultivars of sweet corn as affected by different harvest dates and also to evaluate the effect of temperature on rate of these changes.

II. LITERATURE REVIEW

FACTORS affecting maturation rate

Many papers have been published dealing with the effects of environmental factors on the development of sweet corn. Appleman and Eaton (4) reported that temperature is the controlling factor for the rate of maturation in sweet corn. The exponential indices in which the growth rate doubled for each rise of 18°F, were found to furnish the best criteria of the temperature efficiency for sweet corn. The rate of maturation is inversely proportional to the exponential indices. Magoon and Culpepper (25) found that the longest time required to reach the silking stage was in plantings made early in the spring, the shortest time in plantings made in early summer. The principal factor responsible for these variations was temperature. Hortik, *et al* (20) used a modified regression to estimate the relationships of temperature to the rate development of two cultivars of sweet corn. They reported that in the periods of planting to silking and planting to harvest the relationship was curvilinear. Arnold (5) examined the accuracy of three thermal unit systems. He found that distinct differ -ences were noted for the temperature-rate relationships in three periods: planting to the 4th leaf, 4th leaf to silk, and silk to harvest. He also stated in another paper (6) that total yields of sweet corn were significantly correlated with temperature and suggested that the optimum temperature is 73°F. Several researchers (2) (3) (15) (31) (35) also mentioned the effect of temperature on the rate of sweet corn maturation and on the chemical composition of sweet corn. Stevens et al (37) noted the rapidity with which green corn loses its sugar after picking and the relation of this loss to temperature, and found that the rate at which sugar is lost increases with a rise of temperature at least up to 68°F. In the temperature range up to 86°F the rate of sugar loss is doubled for every increase of 18°F.

Many environmental factors undoubtedly affect growth and development of sweet corn, but temperature in particular is highly correlated with growth. The use of cumulative heat units as a guide in formulating planting schedules and as an estimate for harvest dates for canning crops has increased rapidly in recent years. Barton (9) stated that the use of the heat unit system showed no increase in precision over the use of the number of days system for predicting maturity. Most workers (7) (20) (23) who have compared the accuracy of the heat unit system with a day system to predict corn maturity concluded that days to harvest was more variable than the cumulative heat units. Arnold (5), Barton, et al (8), and Gilmore, et al (17) used a method of calculating degree days, where a 50°F base temperature was subtracted from the daily mean temperature. The method was improved by correcting for temperature below the minimum for growth of 50°F, and above the optimum for growth of 86°F. Gilmore et al (17) reported the number of heat units required for silking remained relatively constant for crops with different planting dates, while calendar days varied widely. Andrew and Weckel (1) calculated an average of 14.7 thermal units required for each percent of kernel moisture loss and found kernel moisture loss was more consistent when expressed by thermal units instead of calendar days.

Rainfall is another important factor affecting the maturation process of sweet corn, especially kernel moisture content. Scott (33) studied moisture tests for corn maturity and reported that if considerable reinfall has occurred within 24 hours prior to testing, the sam -ples will show one or two percent higher moisture content than the same corn may have shown the day before. Similarly, Maurer (27) found that rainfall can cause an apparent reversal in the maturation process of corn. This reversal appears due to an increase in the moisture con -tent of the kernels which leads to a dilution effect on the sugars and starch.

FACTORS affecting yield

Since yield is so important to sweet corn growers many researchers have studied the relationship of yield to factors affecting it. In general, kernel size, kernel depth, number of rows per ear, number of ears, ear fill, husk weight, cob weight, shank length, planting date , harvest date and environmental factors can affect corn yield. Culpepper and Magoon (12) in 1924 showed the weight of the ear continues to increase as harvest date is extended. Fewer rows to the ear and shallow kernels ususlly result in lower yields. Barton (9) in measuring yield of twelve sweet corn cultivars, reported that signifi -cant differences were observed in field yield, husked yield, and cut yield due to each of the following : harvests, years, and cultivars. Haber (18) conducted an experiment where ears were harvested at the canning stage and dry seed stage. There were no apparent differences in the prime weight of ears and the total number of prime ears between the two cultivars tested. Haber (19) reported a high yield variation caused by disease. Marley and Ayres (26) in their study on the influence of planting and harvesting date on corn yield reported that yield was reduced with delayed planting. Statistical analyses indicated a significant difference in yields among the seven harvest dates. Smith , et al (34) gave special attention to yield as influenced by fertilizer treatments and found that sweet corn will respond favorably to a medium level of N, a high level of P, and a low level of K. Huelsen and Gillis (21) reported that yield was significantly correlated with earliness as determined by date of tasseling and silking and concluded that practices which hastened maturity also increased yields of mature corn. Effects of population density and plant arrangement on yield of sweet corn was reported by Mack (24). Yields were increased 35 to 55% as plant population increased from about 12,000 to 52,000 plants per acre under irrigated conditions. According to Cordner (11), supplemental irrigation was of most value during the time the ears were developing even though the rainfall was more deficient earlier in the season. The plots irrigated in the post-silking period only, were as productive as those irrigated before and after silking, while the unirrigated plots or plots irrigated before silking had no significant effect on the yield of green ears.

METHODS for determining maturity

Moisture content of sweet corn has been established as a reliable index for maturity in the canning stage by Culpepper and Magoon (12), Magoon and Culpepper (25), and Scott (33). The optimum time for harvesting was when the kernel moisture was between 70 and 75 per cent according to Magoon and Culpepper (25) and Pratt (29). A comparison of methods for determination by the vacuum oven method was the most re -liable maturity index. However, the method is too time-consuming for rapid field or laboratory screening procedures. A commonly used field evaluation of maturity is the thumb-nail test suggested by Appleman (2), Brecht, et al (10) and Culpepper and Magoon (12). Appleman found that the reliability of this test was greatly influenced by the rate of maturation and also by the rate of water loss by evaporation. Thus , in warm weather the nail test alone is not a reliable means of predicting the best canning stage. Culpepper and Magoon (12) added that it was not a safe guide in estimating the sugar content, especially when applied to different cultivars. The refractometer was reported (9) (32) to be one of the most accurate and one of the quickest methods of predicting sweet corn maturity or moisture content.

The quality of sweet corn is highly variable depending on age or stage of maturity, growing conditions and cultivar. Quality is generally considered to be composed of several primary constituents; sugar, starch, fiber, pericarp, and moisture content. Pericarp and moisture measurements are rather readily defined but chemical composition can not be measured as easily. The toughness of the corn pericarp, as measured by its resistance to puncture, increases continuously through -out the period of its development (13) (14) (25). As toughness increases the quality of the corn is progressively lowered. Culpepper and Magoon (12) reported that there was a great variation in toughness of the pericarp of kernels of different cultivars and at different stages of maturity.

The chief changes in percentage composition of corn during maturation consists in the depletion of sugars and the increase of starch. Appleman and Eaton (4), Culpepper and Magoon (12), Magoon and Culpepper (25), Rosenbrook and Andrew (30), and Rumpf, et al (31) studied these changes and reported that the total sugar content of the very young kernels was medium to low, increased for a time as development proceed -ed, and then decreased as maturity approached. The sucrose was low in the early stages of development, increased rapidly for a time, and then decreased slowly until maturity was complete. Similar changes occurred in reducing sugar. The rate at which the changes occurred depended primarily on the prevailing temperature (2) (4) (36) (38). Temperature effects on sugar content during storage were similar to effects in the field according to Appleman and Arthur (3), and Doty, et al (14). Rumpf, et al (31), using gas chromatographic analysis to determine sugar content, found that ratios of sucrose to fructose and sucrose to glucose concentration were a good measure of the degree of maturity attained. Fertilizer is another factor influencing sugar con -tent in sweet corn. According to Kaldy and Freyman (22) total sugars decreased with increasing rates of nitrogen and phosphorus fertilizers application.

The percentage of starch is suggested to be of equal if not of even greater importance than the sugar content in affecting quality.

The percentage of starch must be sufficiently high to give body to the corn but not so high as to adversely affect textual quality. Appleman and Eaton (4), and Culpepper and Magoon (12) reported that the total polysaccharides, calculated as starch, were found to increase continuously throughout the development and maturation of sweet corn. Tem -perature affects rate of formation of polysaccharides. Rosenbrook and Andrew (30) investigating variation in carbohydrate composition in sweet corn in relation to maturity, found that starch accumulation did not reach its peak until water-soluble polysaccharides accumulation was complete. Very little work has been done to determine fat, crude fiber, and total nitrogen in sweet corn but changes in these constituents appear to be small during the early stages of maturation but may remain fairly constant in later stages of maturation.

III. MATERIALS AND METHODS

The experiments were conducted during the 1976 and 1977 growing seasons at the Oregon State University Vegetable Research Farm, Corvallis. Four cultivars of sweet corn, 'Rapidpak', 'Jubilee', ' Golden Cross Bantam', and 'Tendertreat', were harvested at different stages of maturity. 'Rapidpak' is an early, mid-season cultivar while 'Tendertreat' is about ten days or more later in maturity than 'Rapidpak'. 'Jubilee', and 'Golden Cross Bantam' usually mature about three or four days later than 'Rapidpak'.

The soil was a uniform, deep, loam and well drained. A split-plot design was used throughout with cultivar as main plot and harvest date as subplot. Planting was done on June 4, 1976 and May 24, 1977 with a hand planter. A heavy seeding was made to permit thinning to a uniform plant spacing of about nine inches when the plants were suf-ficiently well developed. Each plot was 25 feet in length with row spacing of three feet and plants were spaced nine inches apart to give a population of 19,300 plants per acre. Each cultivar was replicated five times with six harvest dates. Fertilizer was banded at planting about 2-3 inches below the seed at a rate of 50 lbs N - 66 lbs P - 42 lbs K / A. A rate of approximately 150 lbs N/A was sidedressed when plants were about 36-40 inches high.

Each cultivar was harvested at six stages of maturity. Occasion-al checks of kernel moisture content were made to determine first har-vest. The first harvest was made when kernel moisture content ranged from 78 to 80 per cent. Additional harvests were usually at three day intervals. Harvesting was done in the early morning, usually between 8 a.m. and 10 a.m.. Unhusked and husked weights and numbers of accept -able (good) and cull ears were recorded.

Ten acceptable ears from each plot were selected randomly for both 1976 and 1977 experiments. Samples were combined from five replications at each harvest date for 1976 for a total of 50 ears per harvest for each cultivar. In 1977 samples were cut from the inner two-thirds of the central portion of the ear which were more uniform in maturity. After determining cut corn weight, a small amount of ker -nels for each cultivar was composited and taken for moisture contnet determination. The remainder was steam blanched, washed free of debris while cooling, blast frozen at -40°F and packaged in polyethylene bags , and placed in a freezer for later sugar determination.

A vacuum oven was used to determine moisture content of kernels. A sample of 100 g of kernels was weighed and blended for three minutes in order to obtain a homogeneous sample. Duplicate samples of 10 g were weighed to 0.01 g accuracy on a torsion balance. Samples were then frozen at -40°F for at least an hour before placing them in the vacuum oven to prevent frothing or boiling and to provide a convenient way to hold the samples for one daily loading of the oven. Frozen sam -ples were dried for 24 hours in the vacuum oven at 70°C under a vacuum of 27 inches of mercury. At the completion of the drying period, samples were removed to a desiccator to cool, weighed, and the moisture content of the samples calculated in per cent.

Twenty grams of frozen corn kernels were freeze dried for five days prior to sugar analyses. After drying, the samples were ground to a powder (40 mesh size) and 500 mg of dry powder was weighed on Whatman No 1 filter paper and folded tightly. Samples were placed in 50 ml Erlenmeyer flasks and three ml of 1.5 % solution of arabinose were added as the internal standard, followed by 30 ml of 80 % ethanol. Sugars were extracted by reflux at 70°C for three hours. The extract solution was concentrated by rotary evaporator to a volume of 10 ml. The extract was centrifuged at 19,600 g for 10 minutes. The supernatant was transferred to a 25 ml volumetric flask along with a single washing of the precipitate. The extract was diluted with distilled water to 25 ml. Two ml of each of the diluted extracts were pipetted into 3 ml serum bottles. These samples were then lyophilized for 24 hours. Silylation was performed with 0.2 ml reagent Tri-Sil Z (Pierce Chemical Co., Rockford, Ill) pipetted into each serum bottle immediate -ly after drying. The mixtures were then heated at 60°C for 30 minutes. One µl samples of TMS-sugar derivatives were analyzed by gas chromatography under the following conditions: stainless steel column 6' x 1/8" , packed with 3 % OV-17 on 60-80 mesh Chromosorb WAW, injection port: 275°C, detector: 300°C, oven programmed linearly at 4°C/min from 110-230°C. Gas: Nitrogen = 30 ml/min, Hydrogen = 30 ml/min, Air = 300 ml/min. Flame ionization was used as a kind of detector. Sugars in the samples were tentatively identified by comparison with retention times of authentic TMS-sugar standards and quantitated in reference to the TMS-arabinose internal standard.

Yield data were converted from lbs per plot to tons per acre by multiplying lbs/plot x 0.2904 = tons/acre. Sugars are expressed on a percent dry weight basis. Maximum temperature plus minimum temperature divided by two minus 50, multiplied by 24 give daily degree hours. The number of degree hours necessary to mature a cultivar was obtained by accumulating the daily degree hours above the base from the planting date to harvest date.

Linear or polynomial regression relationships between dependent and independent variables were calculated by methods as described by Neter and Wasserman (26), and Steel and Torrie (34). The equation of regression may be written in the form :

$$Y = a + bX \quad \text{or} \quad Y = a + bX + b'X^2$$

Dependent variables were yield, % moisture, % sugar, etc. while independent variables were date, degree hours, % moisture, etc., or whatever calculations were desired. Variance was used to test the significance of regression. Only those variables that made a significant contribution to regression at 95 % significant level were used.

IV. RESULTS AND DISCUSSION

The seasonal temperature conditions in 1976 and 1977 under which the corn was grown are shown in Figure 1. It can be seen that mean temperatures in 1977 were higher than in 1976, particularly in August which was during the major period of silking and ear development.

TIME and rate of silking

'Rapidpak' was the first of the cultivars to reach the silking period of development. Early silking was observed on August 18, 1976, 75 days after planting, and on August 1, 1977, 69 days after planting. First silking for 'Jubilee' and 'Golden Cross Bantam' was on the some date, August 19 in 1976, 76 days after planting. However in 1977, ' Jubilee' began to silk on August 5, 73 days after planting, while ' Golden Cross Bantam' was observed to silk on August 7, two days later than 'Jubilee'. 'Tendertreat' produced first silks later than the other cultivars because first silks appeared on August 27, 1976, and on August 11, 1977. Data in Table 1 show that the days to silking and degree hours vary from year to year for each of the cultivars. The smaller number of days to silk in 1977 as compared with 1976 was apparently due to an effect of higher temperatures in 1977. However the degree hours to silk in 1977 were higher than for 1976. No data were obtained on soil moisture and evapo-transpiration which would also be related to temperature and may have influenced rate of maturation. Although the heat unit system was no more precise during these two years than the number of days to measure the period from planting to

Fig 1. Mean temperatures during the months of May through October for 1976 and 1977, Corvallis.

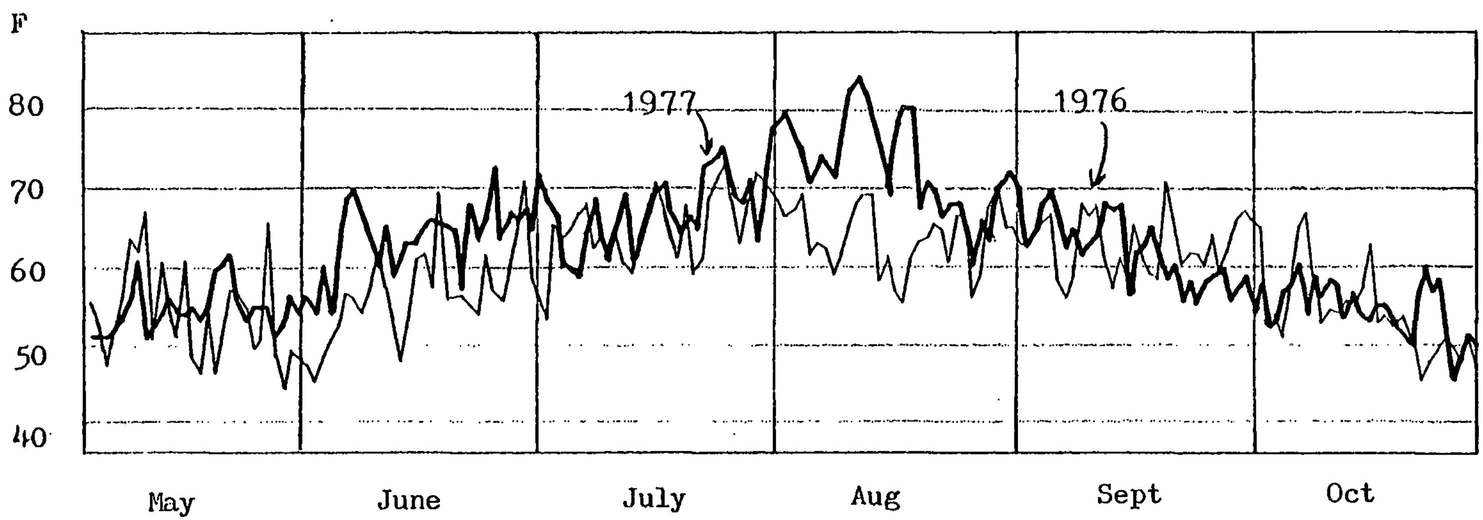


Table 1. Days and Degree Hours required from planting to silking for four cultivars.

cultivar	1976 Days from planting to silking	1976 Degree Hours	1977 Days from planting to silking	1977 Degree Hours
RP	75	22452	69	24744
Jub	76	22776	73	27000
GCB	76	22776	75	28068
TT	84	25332	79	31080

Cultivar abbreviations are as follows :
RP (Rapidpak); Jub (Jubilee);
GCB (Golden Cross Bantam);
TT (Tendertreat)

silking, it may have possible benefits for predicting the stages of maturity and loss of moisture. In Table 2 days and degree hours for various growth stages are given for the four cultivars.

YIELDS

The yield data, in Tables 3 and 4 and in Figures 2 and 3, show that yields increased as harvesting was delayed for three cultivars in both years except for 'Tendertreat'. It is not clear why yields of 'Tendertreat' were erratic during the six harvests. Ears of 'Tendertreat' tend to be rather small diameter with small, shallow kernels, and a relatively large cob. The tip fill of kernels usually was not as good as in other cultivars. These characteristics may have affect -ed its irregular trend in yields. Under conditions of the 1977 experiment, 'Jubilee' produced the highest yields instead of 'Tendertreat', while 'Golden Cross Bantam' produced the lowest yields. The difference may be due in part to the fact that 'Tendertreat' was generally harvested at a higher percentage moisture than other cultivars at each of the harvest dates.

RELATIONSHIP between yields and harvest dates or degree hours

Yield of husked good ears was the primary factor of yield used in all experiments. The changes of yield per day or per degree hour for each cultivar, using regression equations, are indicated in Table 5. 'Rapidpak' increased 0.12 tons per acre for each day delay in harvest in 1976. 'Jubilee' yield increased 0.158 tons per acre per day

Table 2. Days and Degree Hours for various growth stages of sweet corn cultivars in 1976 and 1977.

	1976					1977				
cultivar	harvest date	days from planting	days from silking	degree hours from planting	degree hours from silking	harvest date	days from planting	days from silking	degree hours from planting	degree hours from silking
RP	Sep 13	101	26	31236	8784	Aug 29	97	28	39660	14916
	Sep 15	103	28	31824	9372	Aug 31	99	30	40332	15588
	Sep 17	105	30	32304	9852	Sep 2	101	32	41004	16260
	Sep 20	108	33	33480	11028	Sep 6	105	36	42564	17820
	Sep 22	110	35	33996	11544	Sep 9	108	39	43500	18756
	Sep 24	112	37	34512	12060	Sep 12	111	42	44676	19932
Jub	Sep 15	103	27	31824	9048	Aug 29	97	24	39660	12660
	Sep 17	105	29	32304	9528	Aug 31	99	26	40332	13332
	Sep 20	108	32	33480	10704	Sep 2	101	28	41004	14004
	Sep 22	110	34	33996	11220	Sep 6	105	32	42564	15564
	Sep 24	112	36	34512	11736	Sep 9	108	35	43500	16500
	Sep 27	115	39	35340	12564	Sep 12	111	38	44676	17676
GCB	Sep 17	105	29	32304	9528	Aug 31	99	24	40332	12264
	Sep 20	108	32	33480	10704	Sep 2	101	26	41004	12936
	Sep 22	110	34	33996	11220	Sep 6	105	30	42564	14496
	Sep 24	112	36	34512	11736	Sep 9	108	33	43500	15432
	Sep 27	115	39	35340	12564	Sep 12	111	36	44676	16608
	Sep 29	117	41	36132	13356	Sep 14	113	38	45252	17184
TT	Sep 24	112	28	34512	9180	Sep 6	105	26	42564	11484
	Sep 27	115	31	35340	10008	Sep 9	108	29	43500	12420
	Sep 29	117	33	36132	10800	Sep 12	111	32	44676	13586
	Oct 1	119	35	36876	11544	Sep 16	115	36	45840	14760
	Oct 4	122	38	37044	11712	Sep 19	118	39	46632	15552
	Oct 6	124	40	37572	12240	Sep 21	120	41	47004	15924

Table 3. Yield data for 1976 at six harvest dates.

cultivar	harvest	total unhusked yield	total husked yield T/A	husked good ears wt T/A	cut corn yield T/A [1]	husks wt T/A	no of good ears/plot	50 ears wt lbs	cut corn from 50 ears	% cut off	% good ears	% husks
RP	1	9.21	5.44	4.49	2.19	3.77	36	21.9	10.5	47.9	48.7	40.9
	2	10.10	6.28	5.00	2.53	3.82	36	24.4	12.1	49.6	49.5	37.8
	3	9.12	5.76	5.08	2.84	3.36	37	24.5	13.2	53.9	55.7	36.8
	4	10.70	6.95	5.67	3.01	3.75	37	26.6	14.0	52.6	53.0	35.0
	5	10.00	6.73	5.69	3.60	3.27	36	28.5	17.2	60.3	56.9	32.7
	6	9.80	6.92	5.84	3.43	2.88	35	30.2	16.9	56.0	59.6	29.4
Jub	1	12.80	7.93	5.86	3.24	4.87	44	23.8	12.7	53.4	45.6	38.0
	2	11.80	7.88	6.83	3.79	4.22	48	25.7	13.6	52.9	57.9	33.2
	3	12.70	8.58	7.11	3.79	4.22	48	26.3	13.6	51.7	56.0	33.2
	4	13.50	9.43	7.84	5.58	4.07	50	30.5	19.2	62.9	58.1	30.1
	5	13.30	9.31	7.62	4.11	3.99	44	30.4	16.1	53.0	57.3	30.0
	6	13.20	9.53	7.89	5.13	3.67	46	32.9	19.2	58.4	60.0	27.8
GCB	1	9.24	5.06	4.01	1.95	4.18	35	21.2	9.6	45.3	43.4	45.2
	2	8.16	5.19	4.47	2.05	2.97	35	21.9	10.1	46.1	54.8	36.4
	3	8.10	5.22	4.47	2.90	2.88	34	24.1	14.7	61.0	55.2	35.6
	4	9.22	5.92	5.00	3.13	3.30	35	26.5	15.4	58.1	54.2	35.8
	5	9.61	6.55	5.59	3.31	3.06	37	27.6	15.4	55.8	58.2	31.8
	6	8.79	6.06	5.31	3.20	2.73	34	26.3	16.2	61.6	60.4	31.1
TT	1	16.40	9.57	8.41	3.90	6.83	56	27.5	12.0	43.6	51.3	41.6
	2	12.80	9.21	7.89	3.84	3.59	49	29.1	13.5	46.4	61.6	28.0
	3	14.80	10.80	8.68	4.24	4.00	48	31.6	15.2	48.1	58.6	27.0
	4	14.20	10.80	8.06	5.04	3.40	43	34.2	20.2	59.1	56.8	23.9
	5	14.20	10.80	7.94	4.38	3.40	41	34.2	18.4	53.8	55.9	23.9
	6	14.50	11.30	8.24	4.74	3.20	41	35.6	19.9	55.9	56.8	22.1
average		11.50	7.80	6.73	3.58	3.71	41	27.7	14.1	53.6	55.4	32.3

1 Cut corn yield was calculated from good ears.

Table 4. Yield data for 1977 at six harvest dates.

culti -var	har- vest	total unhusk -ed yiedl	total husked yield T/A	husked good ears wt T/A	cut corn yield T/A	husks wt T/A	no of good ears/ plot	50 ears wt lbs	cut corn from 50 ears lbs	% cut off	% good ears	% husks
RP	1	9.71	6.57	5.87	2.00	3.14	38	3.93	1.81	46.1	60.4	32.3
	2	10.70	7.34	6.18	2.27	3.36	38	4.14	2.06	49.6	57.7	31.4
	3	12.70	8.65	6.97	5.06	4.05	66	4.44	2.64	59.4	54.9	31.9
	4	12.30	8.79	7.14	5.42	3.51	61	4.84	3.06	63.2	58.0	28.5
	5	11.80	8.69	7.27	5.12	3.11	58	4.72	3.04	64.4	61.6	26.4
	6	11.40	8.65	7.38	4.77	2.75	54	4.58	3.04	66.4	64.7	24.1
Jub	1	11.50	7.63	6.85	2.60	3.87	43	4.19	2.08	49.6	59.6	33.6
	2	12.70	8.33	7.33	3.05	4.37	46	4.40	2.28	52.0	57.7	34.4
	3	13.20	8.83	7.47	4.65	4.37	63	4.54	2.54	56.0	56.6	33.1
	4	13.40	9.59	8.37	4.84	3.81	60	5.18	2.78	53.7	62.5	28.4
	5	13.60	9.74	8,36	5.42	3.86	61	5.50	3.06	55.6	61.5	28.4
	6	14.00	10.30	9.22	5.48	3.70	59	5.16	3.20	62.0	65.8	26.4
GCB	1	8.18	5.12	4.02	1.53	3.06	31	3.28	1.70	51.7	49.1	37.4
	2	9.59	5.91	5.13	1.92	3.68	38	3.54	1.74	49.1	53.5	38.4
	3	10.80	7.20	5.64	4.59	3.60	59	4.23	2.68	63.4	52.2	33.3
	4	11.50	7.82	6.35	3.69	3.68	60	4.27	2.12	62.0	53.8	32.0
	5	11.00	7.67	5.81	4.52	3.33	59	4.34	2.64	60.9	52.8	30.3
	6	11.40	8.25	6.13	5.36	3.15	62	4.82	2.98	61.8	53.8	27.6
TT	1	13.30	8.87	6.91	3.03	4.43	45	4.04	2.32	57.3	52.0	33.3
	2	12.70	8.52	6.92	2.93	4.18	45	4.22	2.24	53.1	54.5	32.9
	3	13.70	9.46	6.63	5.35	4.24	72	4.46	2.56	57.4	48.4	30.9
	4	14.70	10.50	7.30	5.94	4.20	71	5.06	2.88	56.9	49.7	28.6
	5	15.10	10.40	7.11	5.90	4.70	71	5.16	2.86	55.6	47.1	31.1
	6	15.00	10.90	7.71	6.27	4.10	71	5.44	3.04	55.8	51.4	27.3
average		12.20	8.49	6.84	4.24	3.76	59	4.52	2.56	56.8	56.1	30.8

Fig 2. Yield of husked acceptable (good) ears for four cultivars and six harvest dates in 1976.

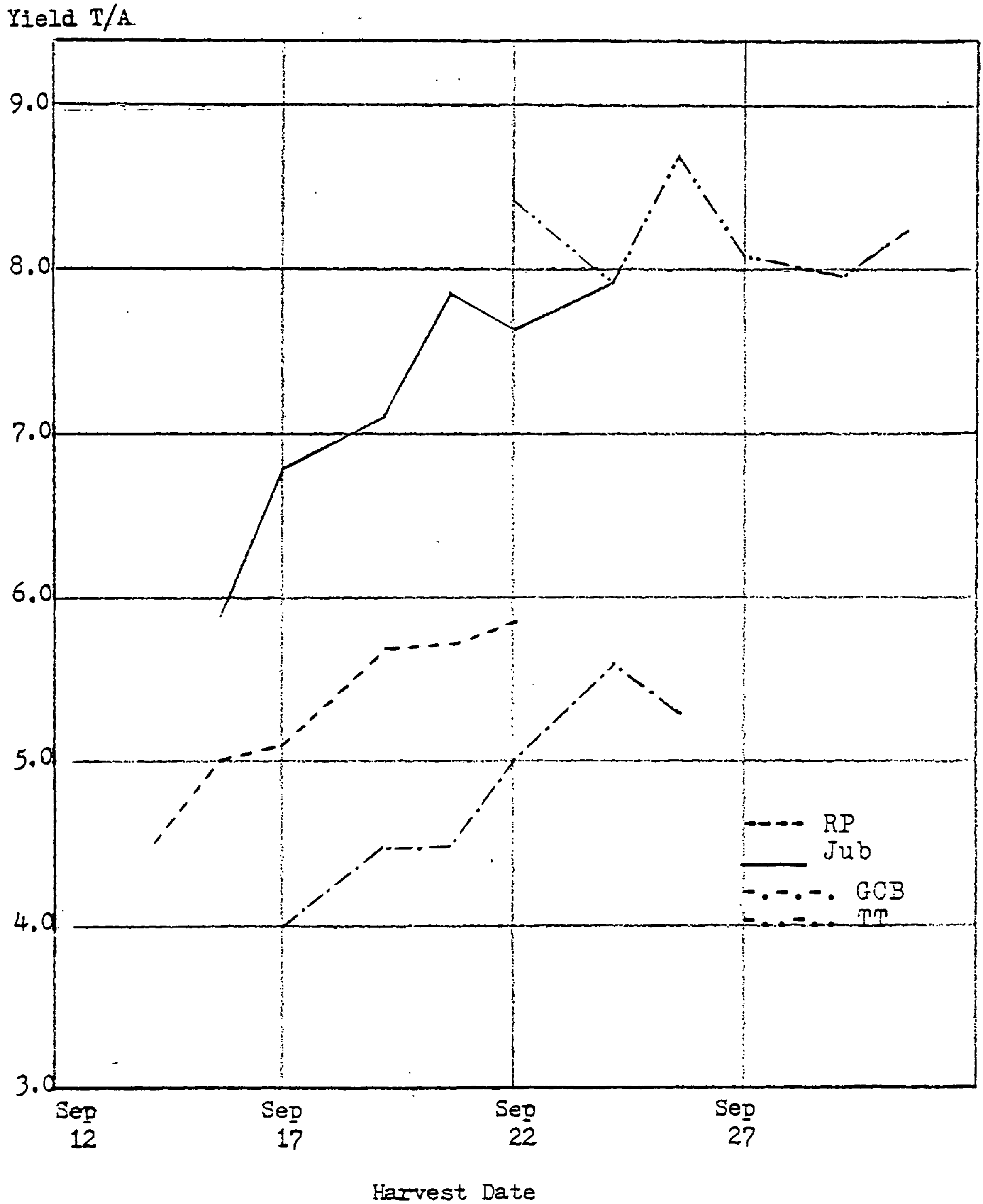


Fig 3. Yield of husked good ears for four cultivars and six harvest dates in 1977.

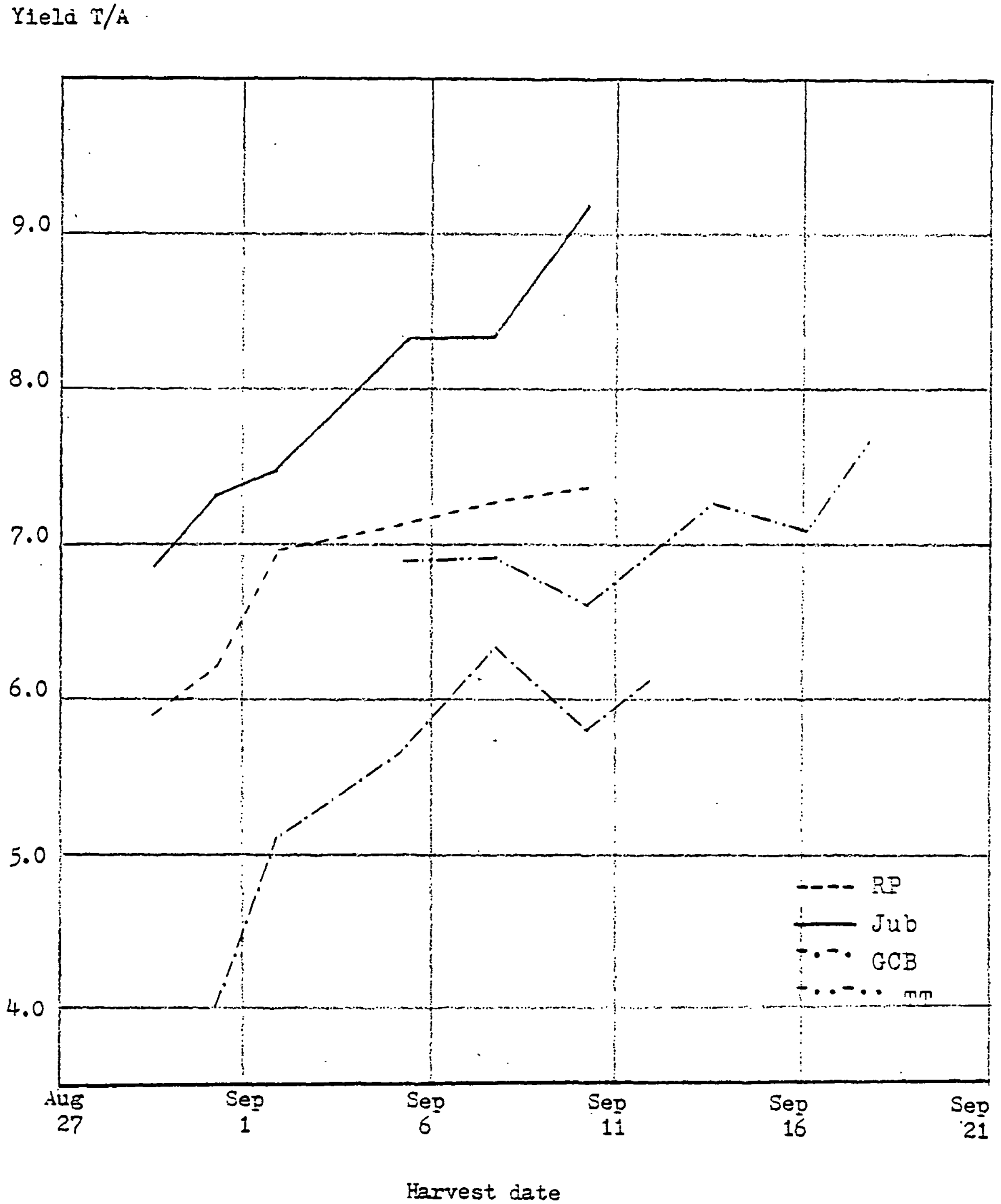


Table 5. Regressions of yield on days and on degree hours from planting to harvest for each cultivar.

culti -var	regression of yield on days	r	regression of yield on degree houre	r
		1976		
RP	-7.47 + 0.12X	.967**	-7.65 + .000394X	.974**
Jub	-10.0 + 0.158X	.908*	-10.6 + .000531X	.912*
GCB	-9.22 + 0.126X	.944**	-9.11 + .000406X	.928**
TT	8.81 - .00177X	.260	10.28 - .0000574X	NS
		1977		
RP	$-120 + 2.34X - .0108X^2$	.979**	$-154 + .0074X - 8.42\text{x}10^{-8}X^2$	.968**
Jub	-8.30 + 0.157X	.980**	-10.5 + .00044X	.984**
GCB	$-211.2 + 3.97X - .0181X^2$	.956*	$-274 + .0127X - 1.45\text{x}10^{-7}X^2$	.953*
TT	1.76 + .00473X	.738	$179 - .00783X + 8.90\text{x}10^{-8}X^2$	NS

* significant

** highly significant

and 'Golden Cross Bantam' had a 0.126 tons per acre increase per day. Average increase in yield was 0.135 tons per acre per day for the three cultivars in 1976 but yield changes may vary among cultivar and years. A linear relationship was also found in regression of yield on degree hours for three cultivars in 1976. About the same estimates of regres -sion were obtained with yield against degree hours as yield on days. Quadratic relationships of yield on days and degree hours were shown for 'Rapidpak' and 'Golden Cross Bantam' in 1977, indicating that there was not as constant change as for a linear regression, thus a direct comparison among the three cultivars can not be made. However, an ad -justed regression to 'Jubilee' at a constant date, 110 days for 1976 and 105 days for 1977, can be calculated for this comparison. In Fig -ures 4 and 5 the differences among three cultivars in yield changes per day are plotted and show that yield of 'Jubilee' increased much more readily than the other two cultivars. During the early part of maturation, 'Rapidpak' had a greater gain in yield than 'Golden Cross Bantam', but later, yield of good ears tended to increase much faster for 'Golden Cross Bantam' than for 'Rapidpak'. No linear or quadratic relationships of yield on days or degree hours were indicated for ' Tendertreat' in both years. Regression of yield on degree hours for the other three cultivars also showed a good fit as on a days basis when comparing their r-value. This indicated that a temperature ef- fect existed on yield of good ears.

MOISTURE

Changes in the moisture content of the different cultivars at

Fig 4. Regression of yield on harvest dates in 1976 , RP and GCB were adjusted to Jub at 110 days after planting.

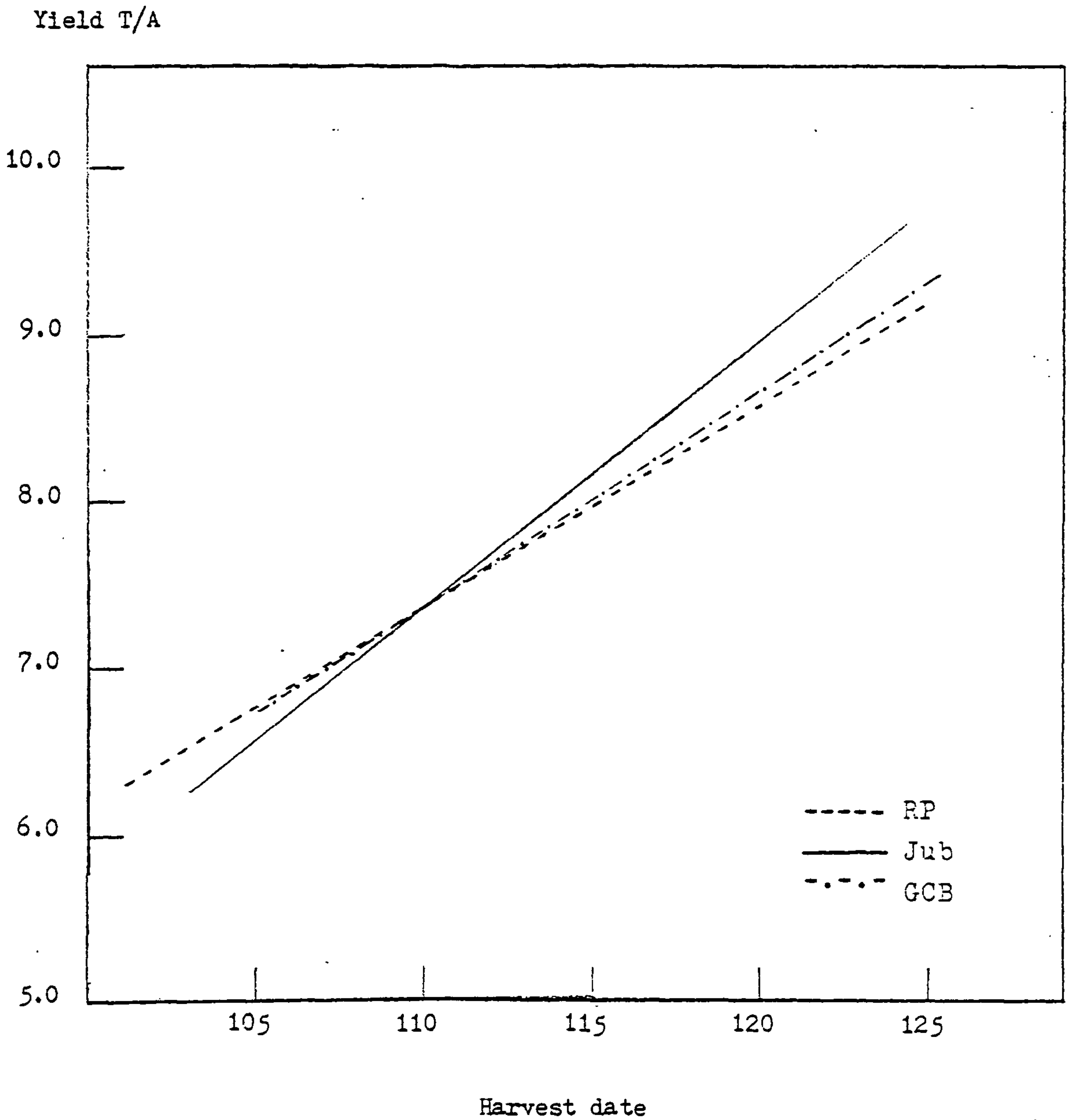
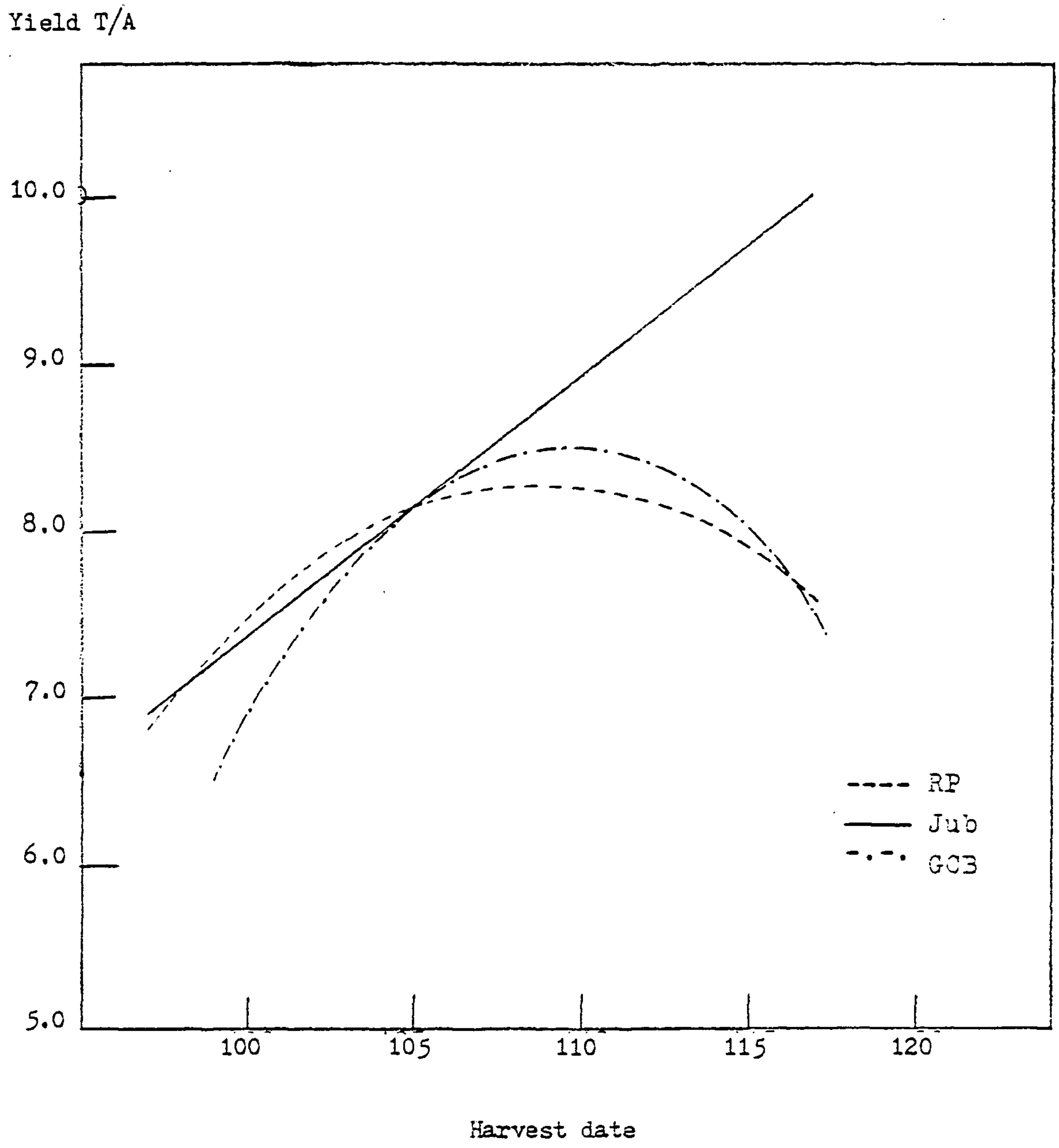


Fig 5. Regression of yield on harvest dates in 1977 adjusted to Jub at 105 days after planting



the various harvest dates, shown in Figures 6 and 7, indicate that moisture loss was more rapid in 1976 than in 1977. In 1976 corn was harvested at an earlier stage of maturity than in 1977 as is indicated by moisture content of kernels at the first harvest date for each cultivar. Rate of loss of kernel moisture was higher in 1976 than in 1977 and was apparently related to the higher prevailing temperature in 1976 as noted in Figures 8 and 9.

RELATIONSHIP between percent moisture and harvest dates or degree hours

The regression of moisture content against days from planting to harvest and degree hours against moisture content shown in Table 6 give the estimates of moisture loss per day and degree hours required for moisture to drop one percent. The decrease in moisture was uniform enough to give significant estimates of regression in the trial. In 1976, the regressions show that moisture loss in 'Golden Cross Bantam' was much faster than for 'Rapidpak' and 'Jubilee' with a 0.887 % loss per day. Moisture loss in kernels of 'Rapidpak' was slower at 0.584% loss per day, while a 0.881 % moisture decrease per day was shown in 'Jubilee'. The decrease in moisture content of 'Tendertreat' was a quadratic relation, that is, it changed differently from day to day, as can be seen in Figure 10. Results from the trial in 1977 indicate that 'Rapidpak' kernels lost 0.44 % moisture per day, while 'Golden Cross Bantam' had 0.67 % moisture loss per day. 'Jubilee' and 'Tender -treat' showed a quadratic relation between moisture content and days which is illustrated in Figure 11. Figures 10 and 11 show a clear re-

Fig 6. Changes in moisture content of kernels of four cultivars at six harvest dates in 1976.

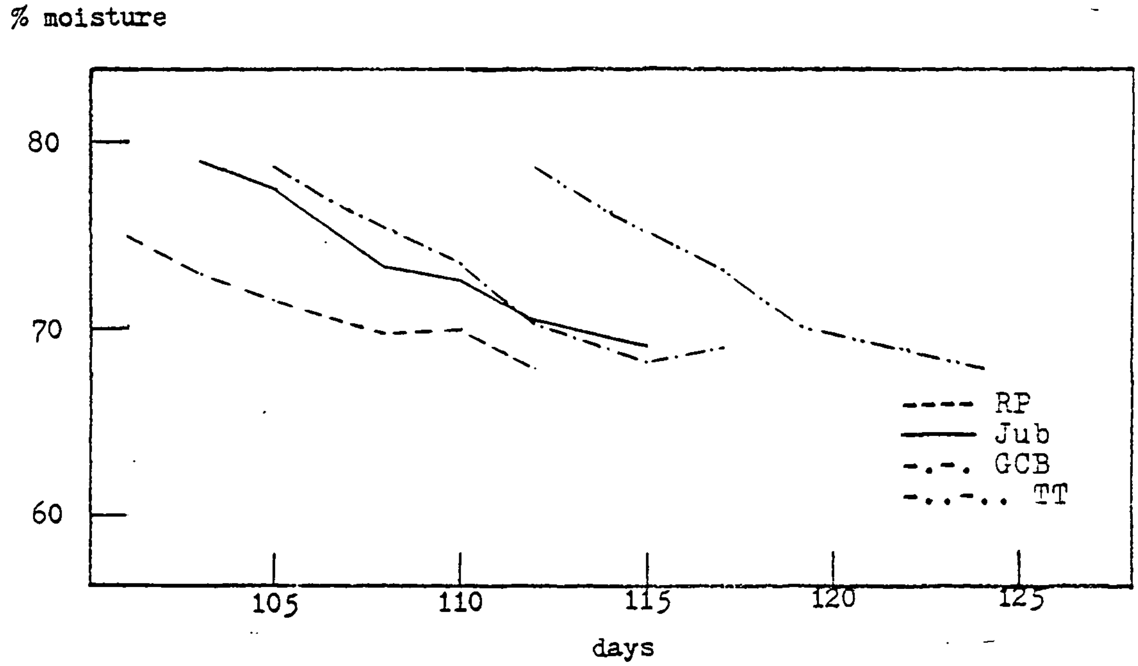


Fig 7. Changes in moisture content of kernels of four cultivars at six harvest dates in 1977.

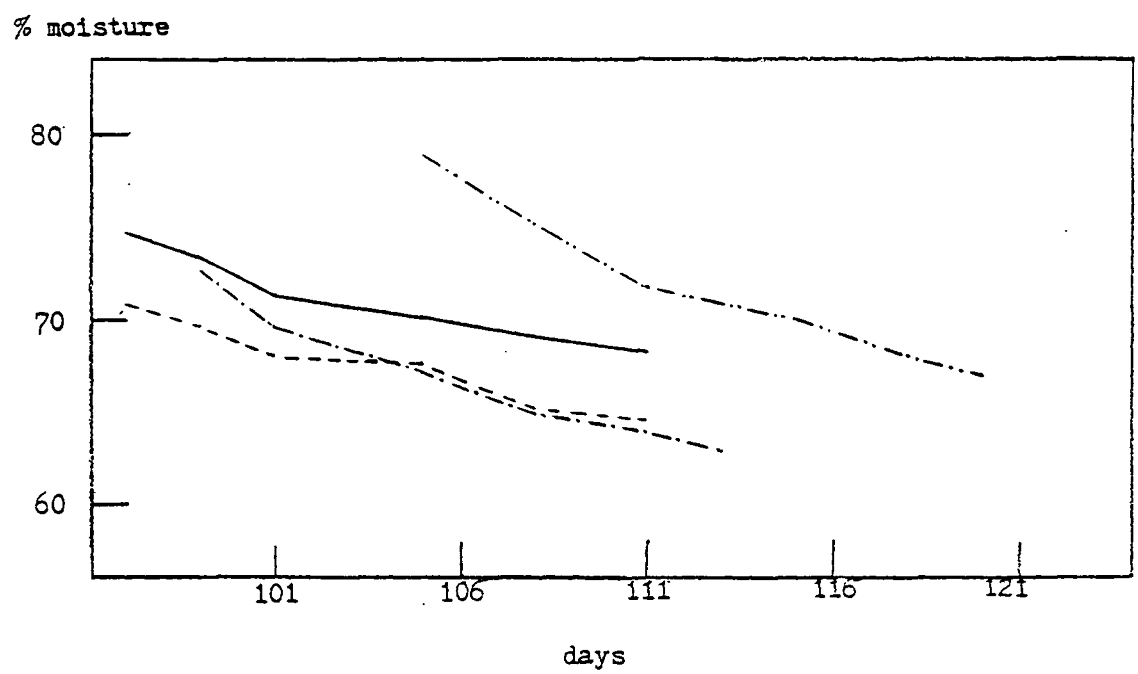


Fig 8. Relationship between mean temperatures and percent moisture changes in kernels for the four cultivars in 1976.

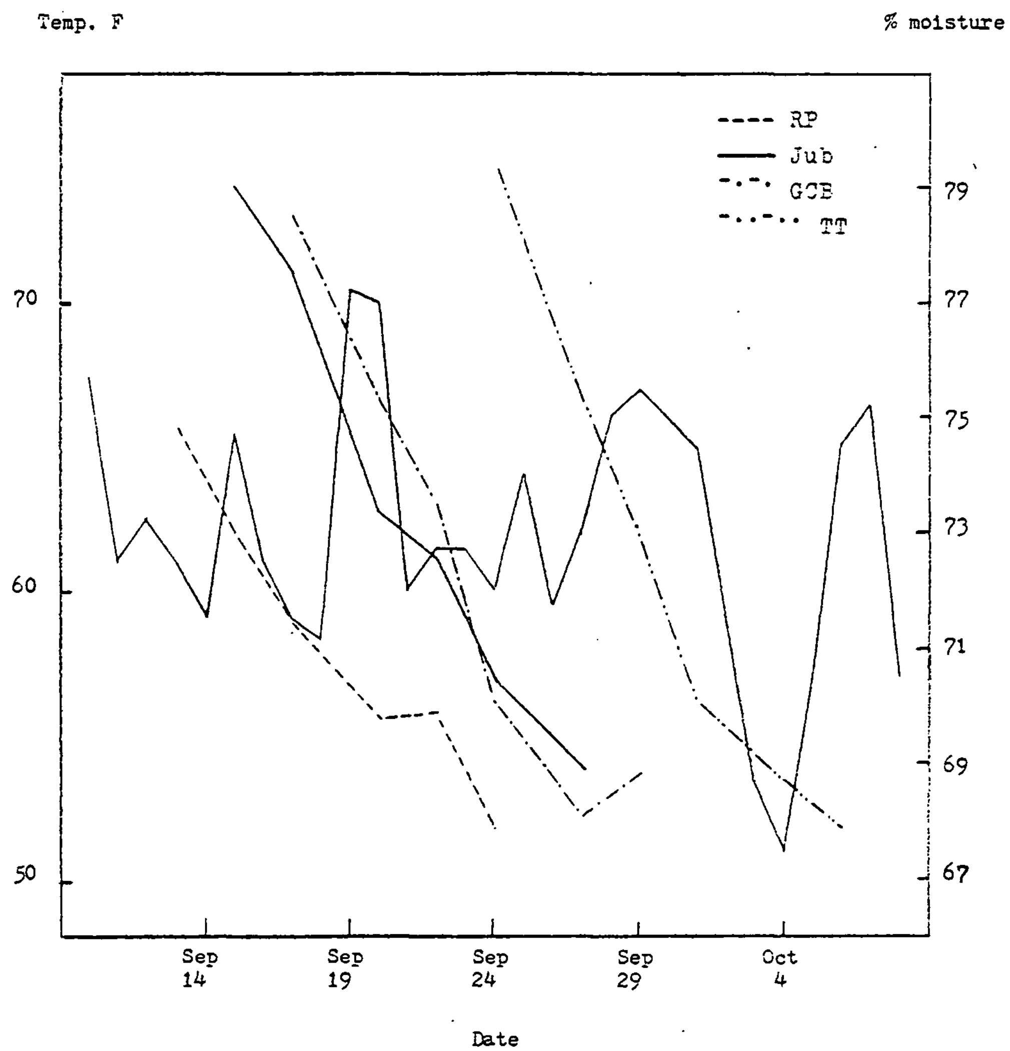


Fig. 9 Relationship between mean temperatures and percent moisture changes in kernels for the four cultivars in 1977.

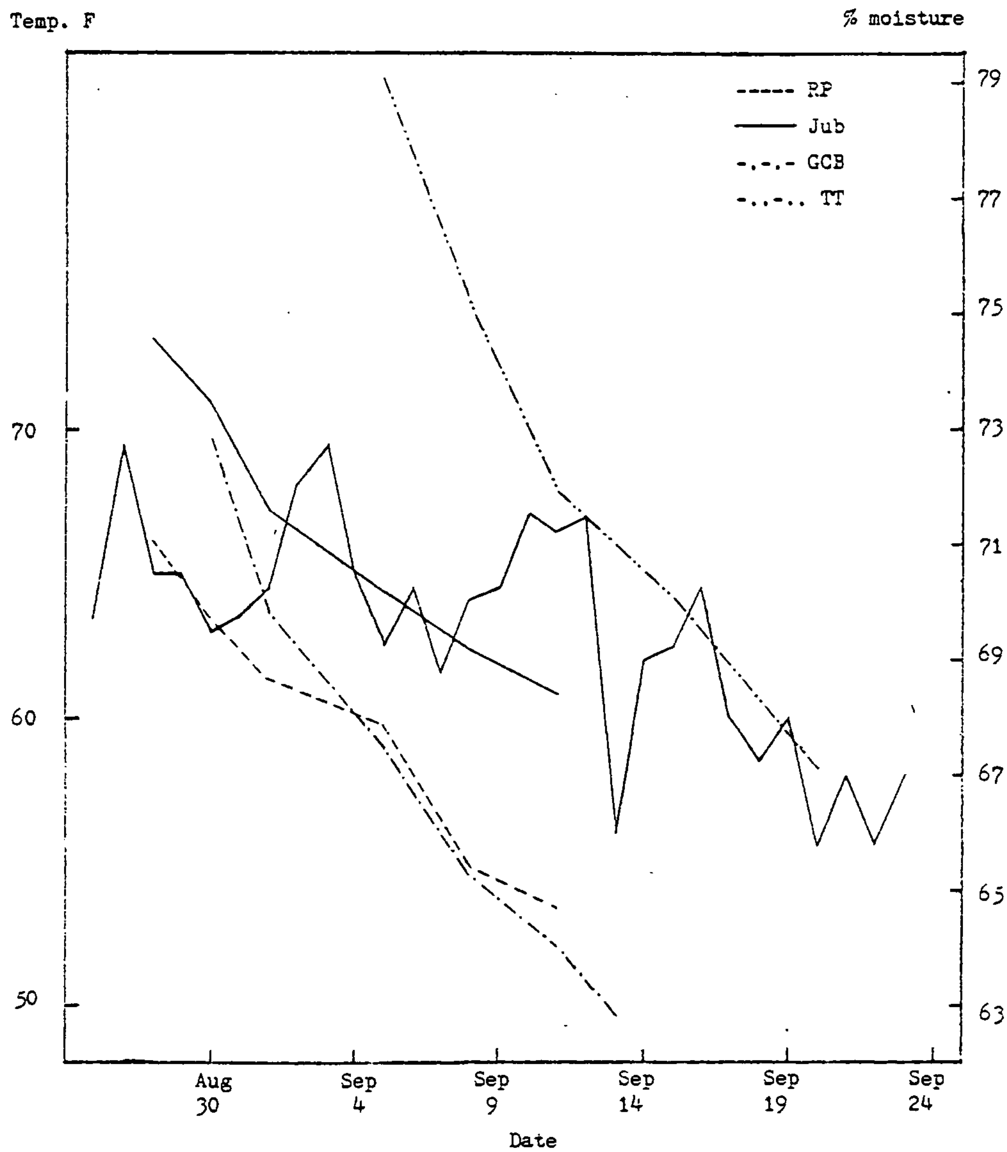


Table 6. Regressions of percent moisture in kernels on days from planting to harvest and on degree hours from planting to harvest, 1976 and 1977.

cultivar	regression of % moisture on days	r	regression of degree hours on % moisture	r
		1976		
RP	$133 - 0.584X$	-.977**	$68424 - 499X$	-.972**
Jub	$169.6 - 0.881X$	-.987**	$58169 - 334X$	-.995**
GCB	$171 - 0.887X$	-.965**	$57185 - 316X$	-.954**
TT	$994 - 14.6X + 0.058X^2$	-.996**	$55110 - 260X$	-.994**
		1977		
RP	$113.5 - 0.441X$	-.977**	$94308 - 772X$	-.971**
Jub	$350 - 4.93X + 0.0216X^2$	-.995**	$592470 - 14635X + 96.9X^2$	-.997**
GCB	$138 - 0.67X$	-.986**	$192220 - 3911X + 25.1X^2$	-.994**
TT	$604 - 8.72X + 0.0354X^2$	-.996**	$153500 - 2597X + 15.1X^2$	-.997**

* significant

** highly significant

Fig 10. Regression of moisture content in kernels on harvest date adjusted to Jub at 72 % moisture content in 1976.

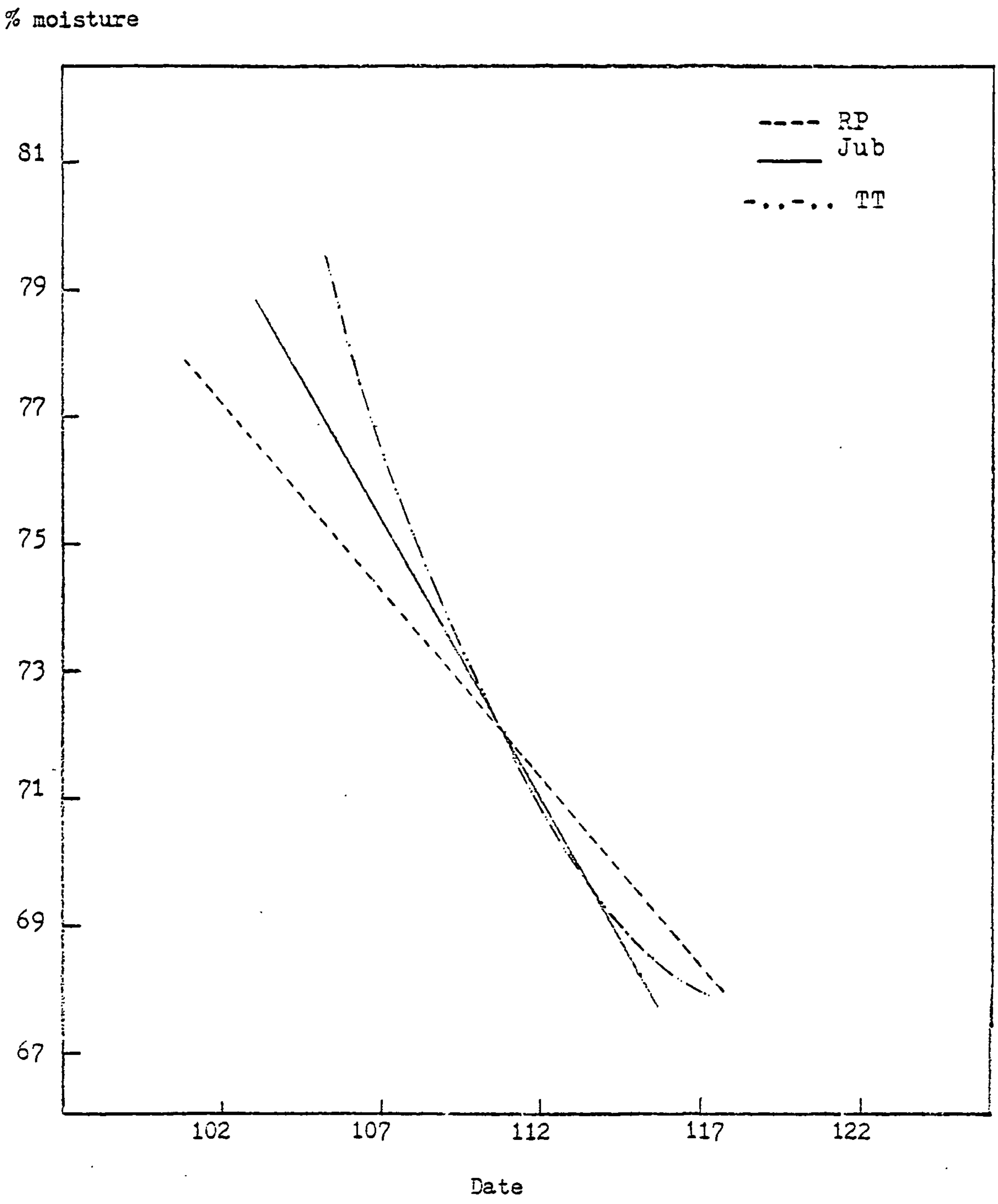
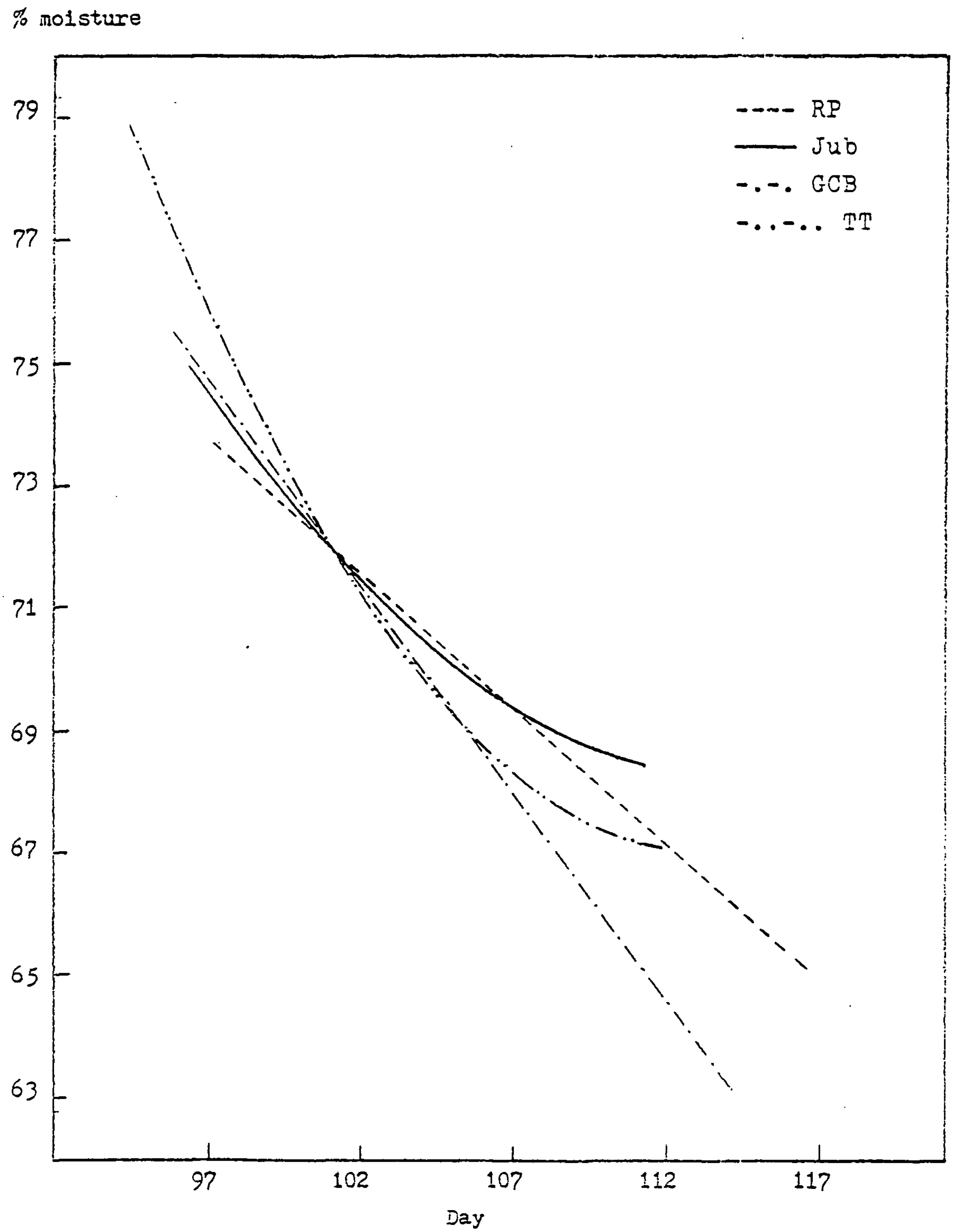


Fig 11. Regression of moisture content in kernels on harvest date adjusted to Jub at 72% moisture content in 1977.



lation of moisture loss among cultivars and indicate that 'Tendertreat' had the highest loss in percentage moisture, while 'Rapidpak' had the lowest. The relationship between moisture content and maturity would indicate that 'Rapidpak' was maturing most rapidly and 'Tendertreat' was the slow-maturing cultivar, and the moisture content during the later harvests was higher than for the other cultivars. The percent moisture content in kernels tends to drop at a reasonably uniform rate on a degree hours basis (Table 6). The upper extreme in this trial was 'Rapidpak' which required 449 degree hours to decrease moisture one percent, while 'Tendertreat' had a one per cent moisture loss in 260 degree hours. This gave a significant estimate of regression and had as accurate a prediction of moisture loss as on a day basis. Thus, it is apparent that temperature affects the changes of kernel moisture. Other factors such as rainfall, irrigation and light intensity, may also affect maturation of sweet corn.

SUGAR concentration

Tables 7 and 8 show the results of sugar analyses for the four cultivars sampled at six harvest dates. In general, the total sugar concentration in sweet corn kernels continues to increase up to a peak in early stages of maturity then decreases rapidly throughout the maturing period. In this study total sugar concentration was beginning to decrease when sampling began, but in some cases there was a peak of sucrose and then decline in some cultivars during the six harvests. Total sugar decreased rapidly at first, then slower, while reducing sugars decreased throughout the harvest period. Ratios of reducing

Table 7. Sugar analyses for sugars of four cultivars of sweet corn sampled at six harvest dates, 1976

cultivar & days from planting	% moisture	total sugar %	reducing sugar %	sucrose %	fructose %	glucose %	sorbitol %	ratio of reducing to sucrose	ratio of fructose to sucrose	ratio of glucose to sucrose
RP										
101	74.9	12.90	2.58	10.2	1.39	1.19	0.17	.253	.136	.117
103	73.1	8.55	1.56	6.73	0.88	0.68	0.26	.232	.131	.101
105	71.5	5.36	0.97	4.22	0.53	0.44	0.17	.230	.126	.104
108	69.8	5.17	0.72	4.17	0.37	0.35	0.28	.173	.089	.084
110	69.9	5.03	0.72	4.09	0.34	0.38	0.22	.176	.083	.093
112	67.9	3.97	0.54	3.27	0.21	0.33	0.16	.165	.064	.101
Jub										
103	79.1	12.70	3.88	8.69	2.01	1.87	0.16	.446	.231	.215
105	77.6	9.65	2.79	6.53	1.44	1.35	0.33	.427	.220	.207
108	73.4	4.89	1.21	3.54	0.55	0.66	0.14	.342	.155	.186
110	72.7	4.72	0.99	3.57	0.48	0.57	0.16	.277	.134	.143
112	70.5	3.28	0.62	2.55	0.29	0.33	0.11	.243	.114	.129
115	68.9	3.48	0.44	2.91	0.19	0.25	0.13	.151	.065	.045
GCB										
105	78.6	11.60	3.10	8.11	1.74	1.36	0.38	.382	.214	.168
108	75.4	5.71	1.42	4.06	0.80	0.62	0.23	.350	.197	.153
110	73.6	6.33	1.11	5.07	0.52	0.59	0.15	.219	.103	.116
112	70.2	4.74	0.77	3.82	0.39	0.38	0.15	.202	.102	.099
115	68.2	4.13	0.73	3.31	0.32	0.42	0.09	.224	.097	.127
117	68.8	4.39	0.72	3.49	0.32	0.40	0.18	.206	.092	.115
TT										
112	79.4	15.00	5.68	9.10	3.01	2.67	0.20	.624	.331	.293
115	75.3	14.90	4.19	10.50	2.06	2.13	0.23	.399	.196	.203
117	72.9	9.76	1.97	7.50	1.01	0.96	0.29	.263	.135	.128

Table 7 continued

TT										
119	70.2	8.06	1.81	6.05	0.92	0.89	0.20	.299	.152	.147
122	68.7	7.94	1.76	6.00	0.88	0.88	0.18	.293	.147	.147
124	67.9	7.39	1.30	5.92	0.59	0.71	0.17	.220	.100	.120

Table 8. Sugar analyses for sugars of four cultivars of sweet corn sampled at six harvest dates, 1977

cultivar & days from planting	% moisture	total sugar %	reducing sugar %	sucrose %	fructose %	glucose %	sorbitol %	ratio of reducing to sucrose	ratio of fructose to sucrose	ratio of glucose to sucrose
RP										
97	71.1	5.94	0.71	5.02	0.40	0.31	0.21	.141	.080	.062
99	69.7	3.70	0.45	3.10	0.19	0.26	0.15	.145	.061	.084
101	68.2	4.14	0.52	3.43	0.18	0.34	0.19	.154	.052	.099
105	67.8	3.35	0.63	2.55	0.12	0.51	0.17	.247	.047	.200
108	65.4	3.07	0.66	2.27	0.11	0.55	0.14	.291	.048	.242
111	64.7	4.35	0.89	3.28	0.20	0.68	0.18	.271	.061	.207
Jub										
97	74.6	6.27	1.11	5.05	0.53	0.57	0.11	.220	.105	.113
99	73.5	6.10	1.10	4.84	0.54	0.56	0.16	.227	.112	.116
101	71.6	5.86	0.87	4.76	0.37	0.50	0.23	.183	.078	.105
105	70.2	3.18	0.63	2.40	0.15	0.48	0.15	.262	.062	.200
108	69.2	3.57	0.86	2.53	0.17	0.69	0.18	.340	.067	.273
111	68.4	3.72	0.82	2.71	0.13	0.69	0.19	.303	.048	.255
GCB										
99	72.8	6.37	1.06	5.15	0.55	0.51	0.16	.206	.107	.099
101	69.8	5.23	0.73	4.33	0.37	0.38	0.17	.169	.085	.088
105	67.5	4.21	0.65	3.39	0.23	0.42	0.17	.192	.068	.124
108	65.3	2.99	0.45	2.40	0.17	0.28	0.14	.187	.071	.117
111	64.1	3.22	0.62	2.44	0.12	0.49	0.16	.254	.049	.201
113	62.8	2.64	0.61	1.93	0.09	0.52	0.10	.316	.047	.269
TT										
105	79.1	11.00	3.70	7.04	1.94	1.75	0.22	.526	.276	.249
108	75.2	10.00	2.11	7.69	1.04	1.07	0.21	.274	.135	.139
111	71.9	8.47	1.77	6.39	0.87	0.91	0.31	.277	.136	.142
115	70.1	6.22	1.07	5.00	0.51	0.55	0.15	.214	.102	.110
118	68.3	4.87	0.81	3.93	0.36	0.44	0.13	.206	.092	.112
120	67.2	5.27	0.79	4.31	0.30	0.56	0.17	.199	.070	.130

sugar to sucrose, fructose to sucrose, and glucose to sucrose are also indicated in Tables 7 and 8. The ratio of fructose to sucrose decreased throughout the maturing period which may be a good measure or indication of the degree of maturity. It is generally considered most desirable for canned corn to contain about $5\frac{1}{2}$ per cent of sugar, 10 percent of starch, and 72 per cent moisture (4) (12) (15). In the present study, a 1:10 ratio of fructose to sucrose is also proposed, since Tables 7 and 8 show that the 1:10 ratio of fructose to sucrose corresponded with approximately 72 per cent moisture and 5-6 per cent total sugar for the cultivars in both years, with very few exceptions. The ratio of reducing sugar to sucrose decreased in the 1976 samples, while this ratio in the 1977 samples decreased then increased irregularly. The increase occurred when the kernel moisture was below 67 percent. The different sampling techniques in 1976 and 1977 may have affected results, since in 1977, kernels for sugar determination were cut from the central portion of the cob. Usually, kernels from the basal part of the ear mature faster than those at the tip of the ear. Consequently, removal of basal and tip portion of the ears may have affected the results of sugar concentration especially in overmature stages. Sorbitol and maltose are also sugar components of sweet corn, but they were found in very small amount.

CHANGES in sugar concentration

It has generally been assumed that sucrose furnishes the prime sweetness of sweet corn; when sucrose concentration is highest, kernels of sweet corn are sweetest. Changes in sugar concentration, both total sugar and sucrose concentration, are emphasized in this study and curves for the four cultivars at different harvest dates are shown in Figures 12, 13, 14, and 15. Total sugar concentration in kernels generally decreased more rapidly in 1976 than in 1977 and changes were affected by different harvest dates and the prevailing temperatures. Regressions of sugar content against days and degree hours shown in Tables 9 and 10, and in Figures 16, 17, 18, and 19, indicate the changes in detail. Most relationships of total sugar and of sucrose concentrations of kernels against harvest date were quadratic. These regressions indicated that 'Tendertreat' in 1976 had a slow decrease of total sugar in kernels, while in 'Jubilee' sugar concentration decreased much faster. However, in 1977, the rate of change was quite different with 'Tendertreat' showing the most rapid decrease and 'Jubilee' showed the slowest decrease. In 'Rapidpak' there was no significant relationship in sugar loss and harvest date. Average percent total sugar decreased 0.589 % for each day's delay of harvest for three cultivars in 1976 and 0.304 % in 1977. Difference of sugar concentration loss between two years was apparently due to higher temperatures occurring during harvest in 1976 than those in 1977. Also from Tables 9 and 10, comparisons of r-value between days system and degree hours system showed that there was the same accuracy of prediction for sugar concentration. Thus it can be concluded that changes of sugar concentration were affected by prevailing temperatures. The variations in sucrose concentration among cultivars were not very marked. There was a slight increase in percent sugar concentration in kernels in some cultivars at the end of harvest period. The rate of starch synthesis

Fig 12. Total sugar concentration (as % of dry weight) in sweet corn kernels of four cultivars at different harvest dates in 1976.

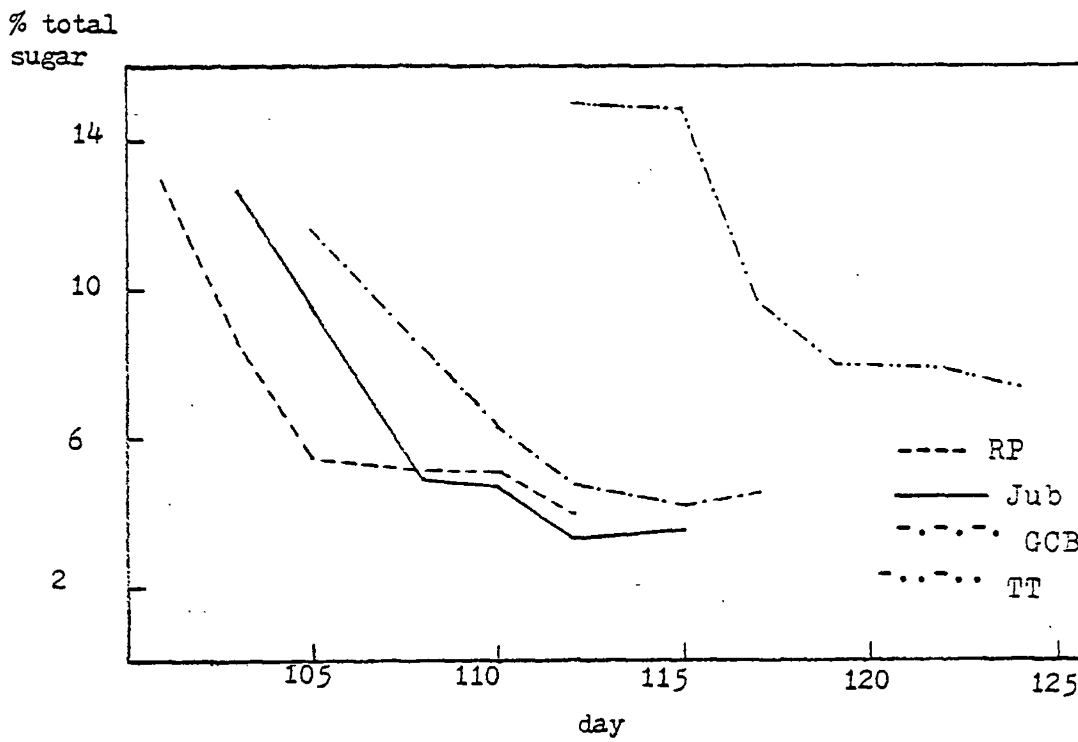


Fig 13. Total sugar concentration (as % of dry weight) in sweet corn kernels of four cultivars at different harvest dates in 1977.

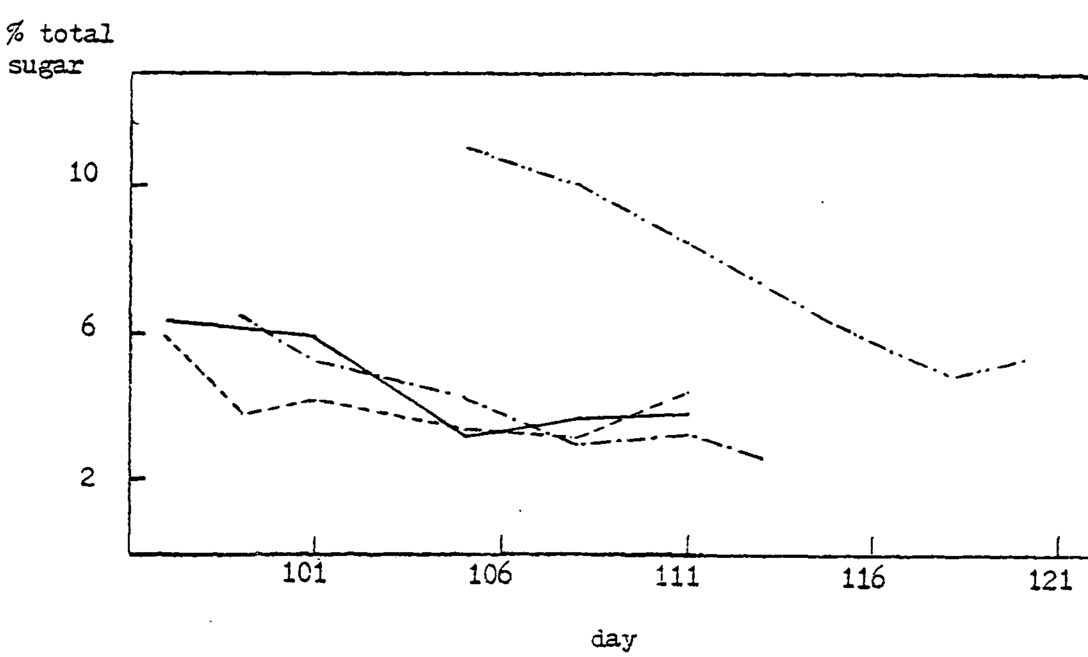


Fig 14. Sucrose concentration as % of dry weight in sweet corn kernels of four cultivars at different harvest dates in 1976.

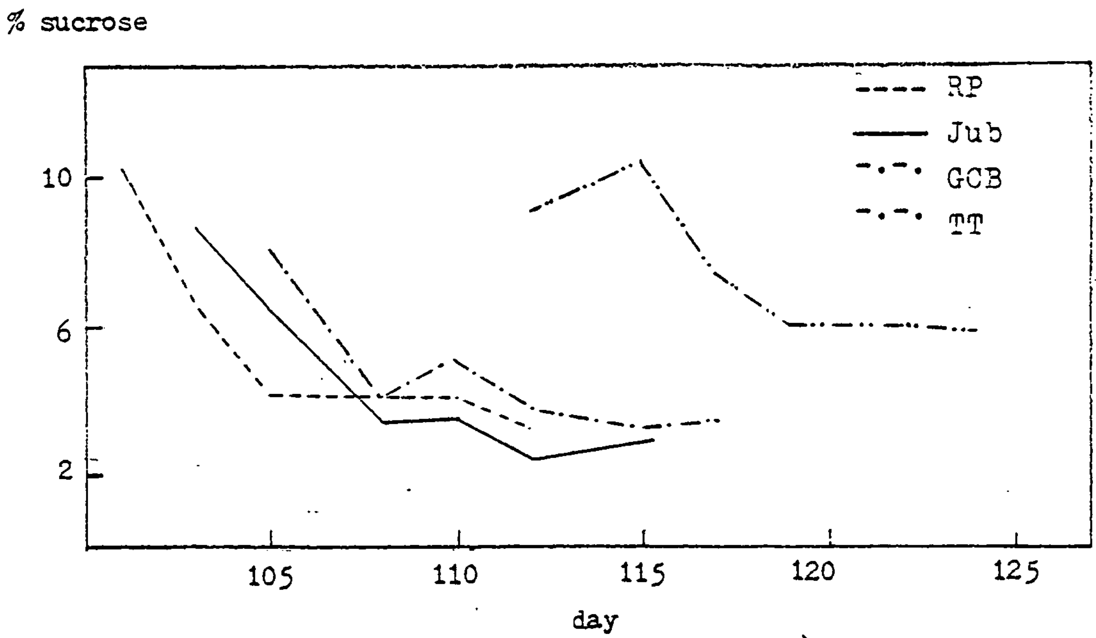


Fig 15. Sucrose concentration as % of dry weight in sweet corn kernels of four cultivars at different harvest dates in 1977.

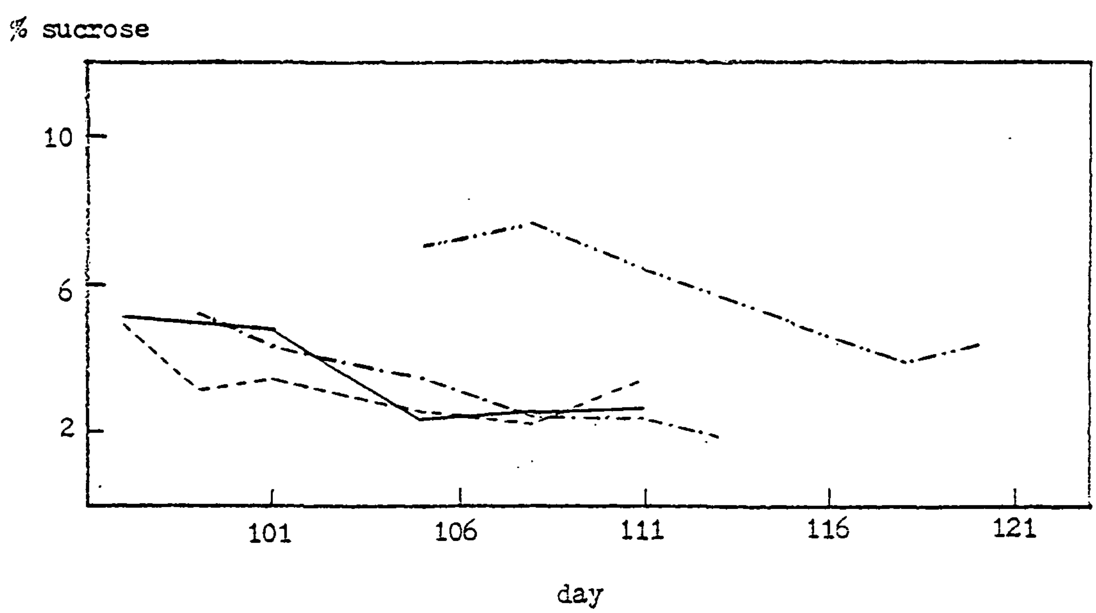


Table 9. Regressions of total sugar concentration in kernels on days and on degree hours, 1976 and 1977.

cultivar	regression of total sugar on days	r	regression of total sugar on degree hours	r
		1976		
RP	$1333 - 24.2X + 0.11X^2$	.966*	$7.11 - 8.91 \times 10^{-6}X$	NS
Jub	$1200 - 21.2X + .0936X^2$	.993**	$1201 - 0.069X + 9.84 \times 10^{-7}X^2$	.995**
GCB	$1075 - 18.7X + .082X^2$	.955*	$975 - 0.055X + 7.76 \times 10^{-7}X^2$	.852**
TT	$95.2 - 0.72X$	.902*	$117 - .00293X$	.954**
		1977		
RP	$14.0 - 0.0959X$	NS	$526 - 0.0246X + 2.88 \times 10^{-7}X^2$	NS
Jub	$28.7 - 0.231X$	.876*	$34.4 - .00065X$	.882*
GCB	$214 - 3.72X + .0164X^2$	.986**	$34.4 - .000707X$	.956**
TT	$56.3 - 0.43X$	.983**	$72.2 - .00143X$	.990**

* significant

** highly significant

Table 10. Regressions of per cent sucrose concentration in kernels on days and on degree hours, 1976 and 1977.

culti -var	regression of % sucrose on days	r	regression of % sucrose on degree hours	r
		1976		
RP	$1066 - 19.4X + 0.089X^2$	.963*	$1212 - 0.072X + 1.07 \times 10^{-6}X^2$	.950*
Jub	$823 - 14.6X + 0.065X^2$	.991**	$830 - 0.0476X + 6.86 \times 10^{-7}X^2$	.993**
GCB	$41.3 - 0.329X$	NS	$594 - 0.0333X + 4.71 \times 10^{-7}X^2$	.944*
TT	$50.0 - 0.36X$	.833*	$60.5 - 0.00146X$	.878*
		1977		
RP	$352 - 6.62X + 0.0313X^2$	NS	$454 - 0.0211X + 2.47 \times 10^{-7}X^2$	NS
Jub	$25.6 - 0.211X$	.892*	$28.6 - .000593X$	.897*
GCB	$152 - 2.59X + 0.0112X^2$	.991**	$29.9 - .00062X$	.972**
TT	$33.5 - 0.246X$	.936**	$42.3 - .000813X$	.938**

* significant

** highly significant

Fig 16. Regression of total sugar concentration in kernels on harvest date adjusted to Jub at 5% total sugar in 1976.

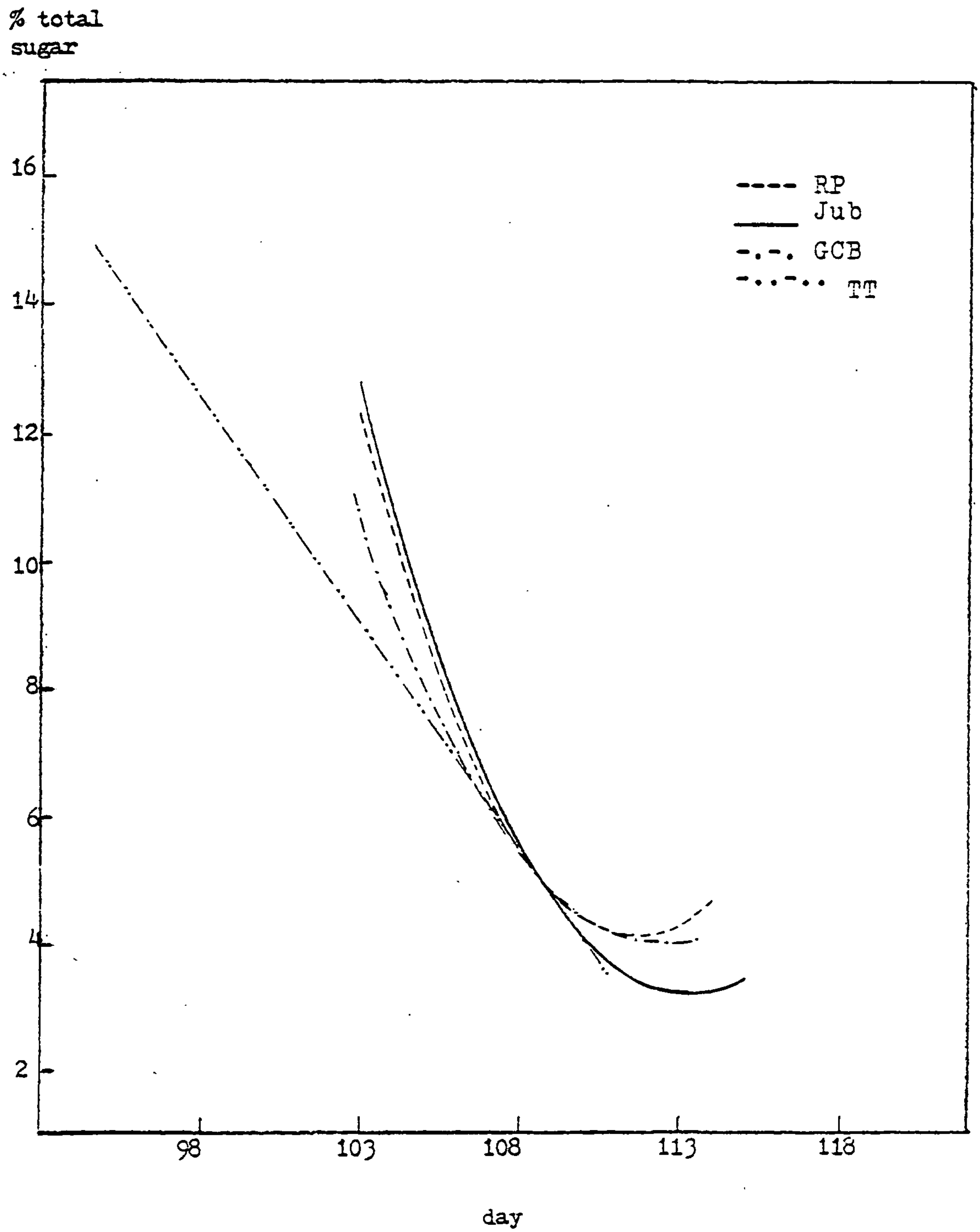


Fig 17. Regression of total sugar concentration in kernels on harvest date adjusted to Jub at 5% total sugar in 1977.

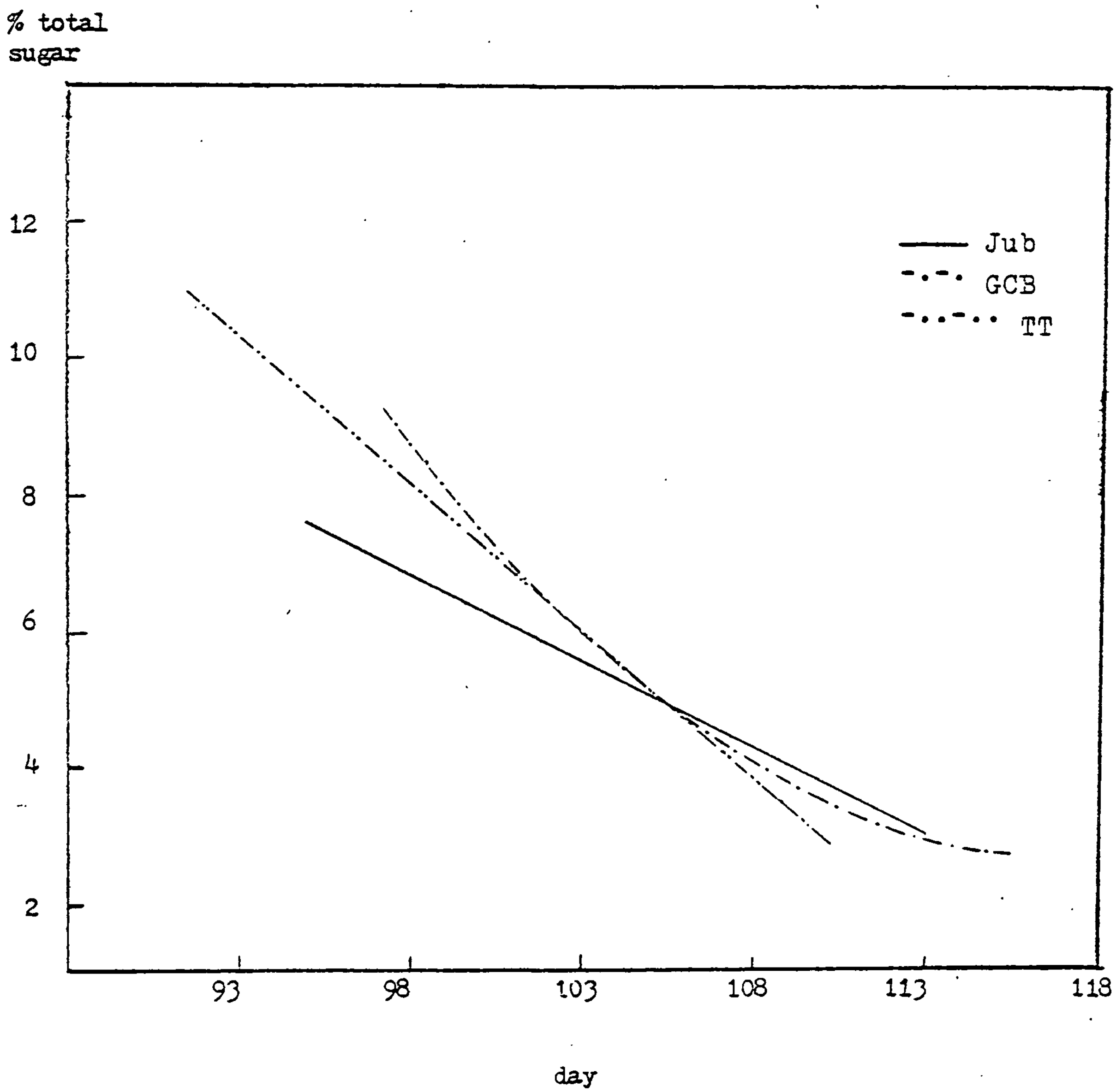


Fig 18. Regression of sucrose concentration in kernels on harvest date adjusted to Jub at 5% sucrose concentration in 1976.

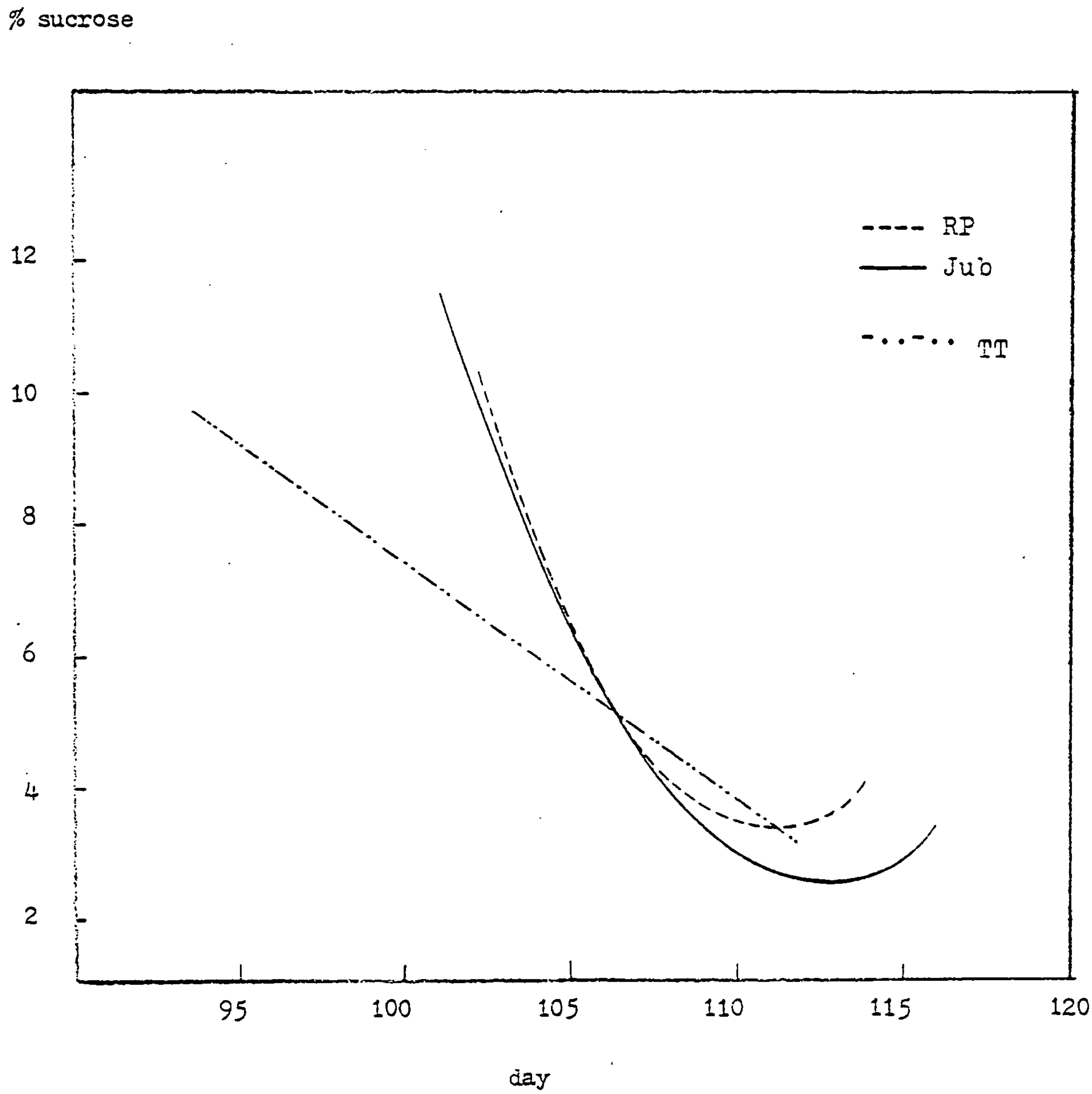
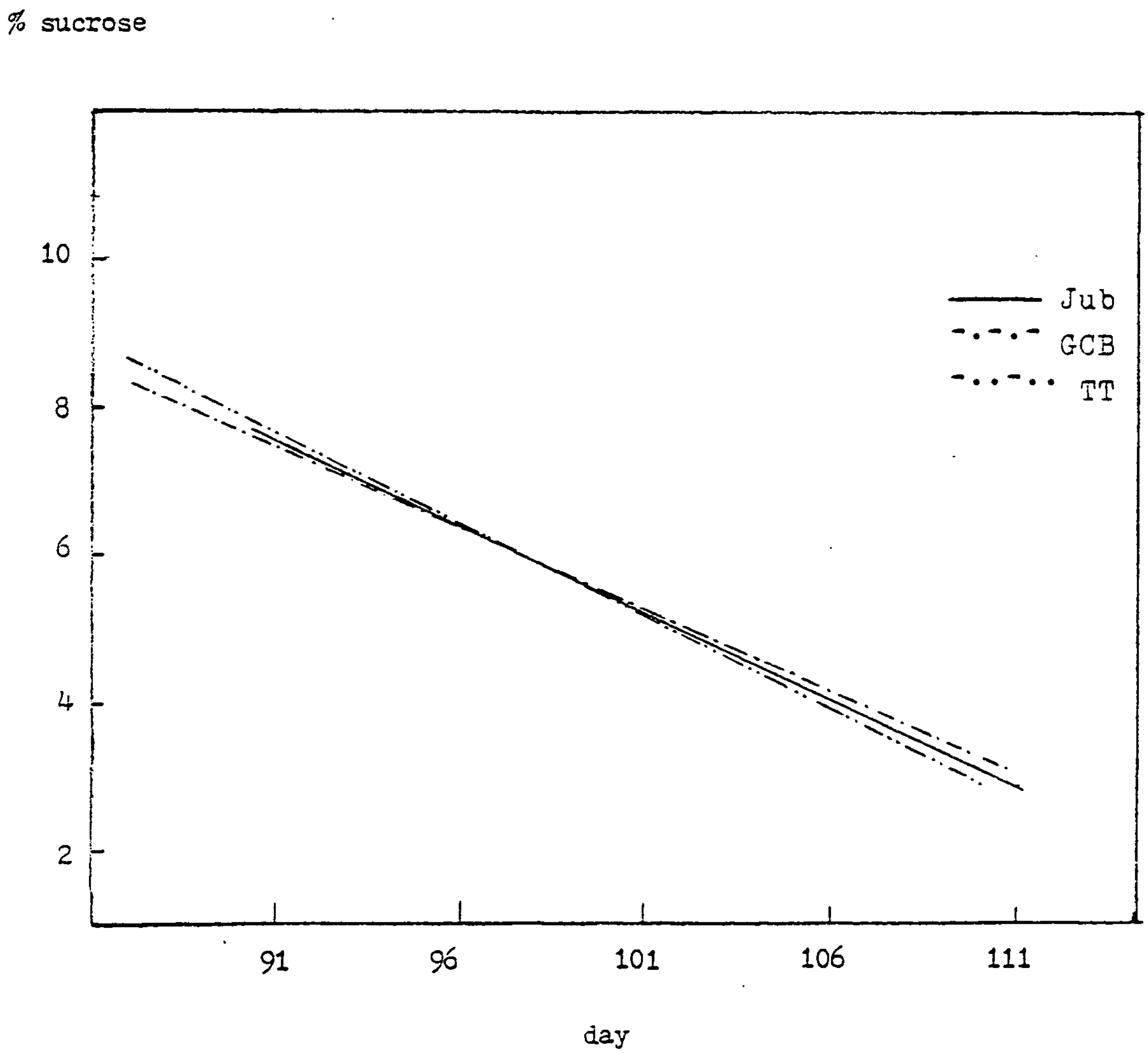


Fig 19. Regression of sucrose concentration in kernels on harvest date adjusted to Jub at 5% sucrose concentration in 1977.



in the kernels and temperature may have been controlling factors, since high temperature will hasten starch synthesis and some sugars in the cob and stem will be transported into the kernels for starch formation as the sugar in the kernels is depleted. Starch determinations were not made in this study, but the rate of starch synthesis controlling several supplementary processes in the maturation of the corn has been studied by others (4) (11). Starch concentration should also be considered in determining best canning quality.

RELATIONSHIPS of yield and sugar concentration to percent moisture content in kernels

The most widely used estimate for sweet corn maturity is measure-ment of moisture content of kernels. Regressions of relationships of moisture content, yield and sugar concentration are shown in Table 11. The correlation coefficients indicate that yield and total sugar concentration were significantly related to moisture content. Figures 20, 21, 22 and 23 show the variations of yield and sugar concentration when percent moisture content in kernels changed. Yield of 'Rapidpak' increased the most rapidly for each per cent loss in moisture while yield of 'Golden Cross Bantam' increased the least in 1976 and 1977. The regression of total sugar against moisture content was not as consistent from year to year as that of yield against moisture content of kernels (Figures 22 and 23).

Adjustments of yield and total sugar were calculated from the moisture content in this study and results are shown in Table 12. A moisture content of 72 per cent was used as a standard base to compare

Table 11. Regression of yield and total sugar concentration of kernels against moisture content of kernels for four cultivars of sweet corn, 1976 and 1977.

culti -var	regression of yield on moist content	r	regression of total sugar on moisture contetn	r
		1976		
RP	19.6 - 0.20X	.972**	982 - 28.5X + $0.21X^2$	.989**
Jub	20.2 - 0.18X	.907*	-62.0 + 0.93X	.957**
GCB	15.0 - 0.14X	.974*	455 - 12.9X + $0.092X^2$	.961*
TT	58.4 + 0.0453X - $1.74x10^{-4}X^2$	NS	-44.2 + 0.75X	.937**
		1977		
RP	-166 + 5.35X - $0.041X^2$	.977**	659 - 19.6X + $14.6X^2$	NS
Jub	32.2 - 0.34X	.956**	-32.3 + 0.52X	.886*
GCB	-97.2 + 3.24X - $0.0254X^2$	.972**	-21.5 + 0.38X	.986**
TT	81.3 - 1.99X + $0.0132X^2$	NS	-32.0 + 0.55X	.966**

* significant

** highly significant

Fig 20. Regression of yield on per cent moisture content in kernels in 1976, curves adjusted to Jub at 72% moisture.

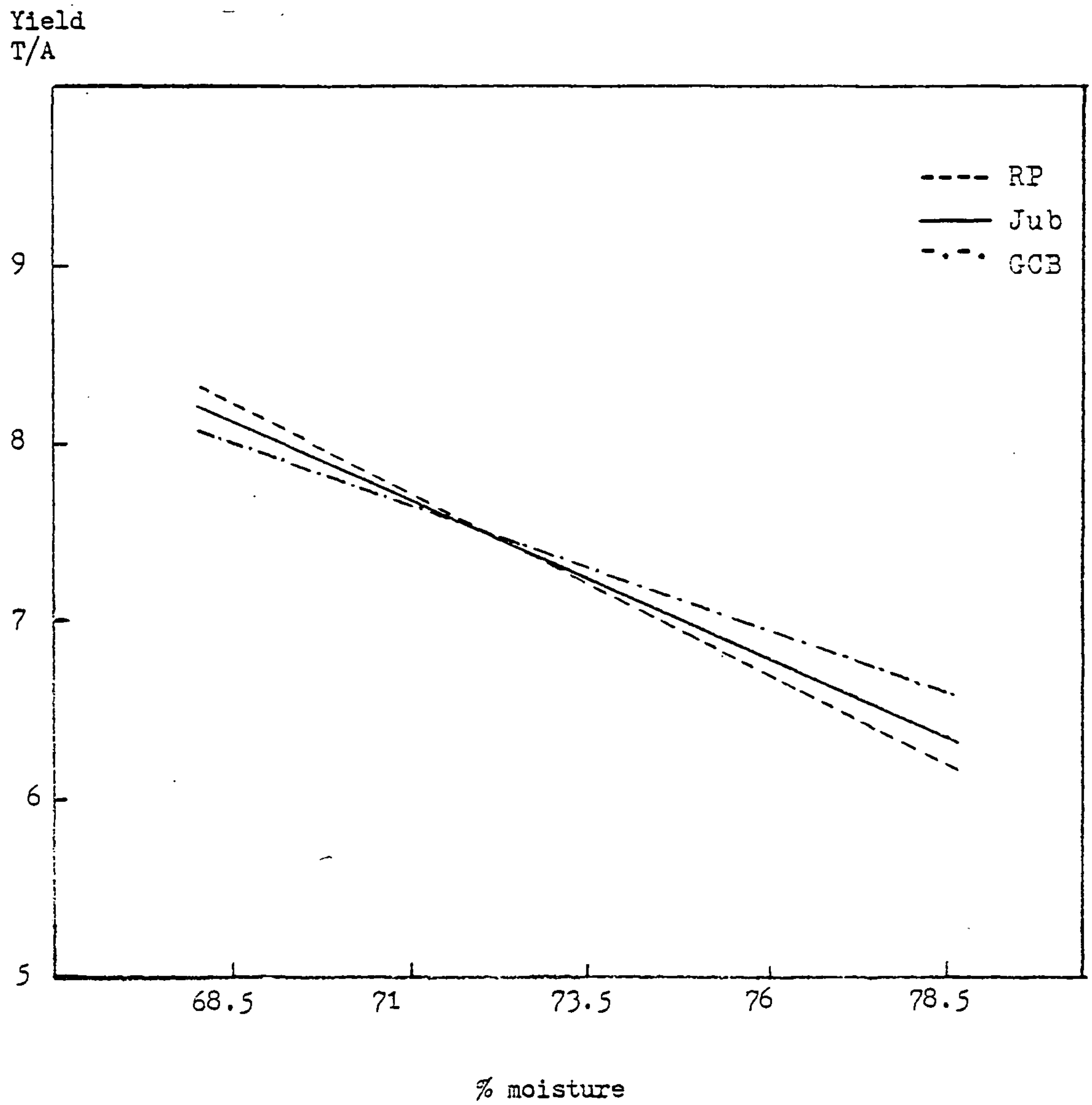


Fig 21. Regression of yield on per cent moisture content in kernels curves adjusted to Jub at 72% moisture in 1977.

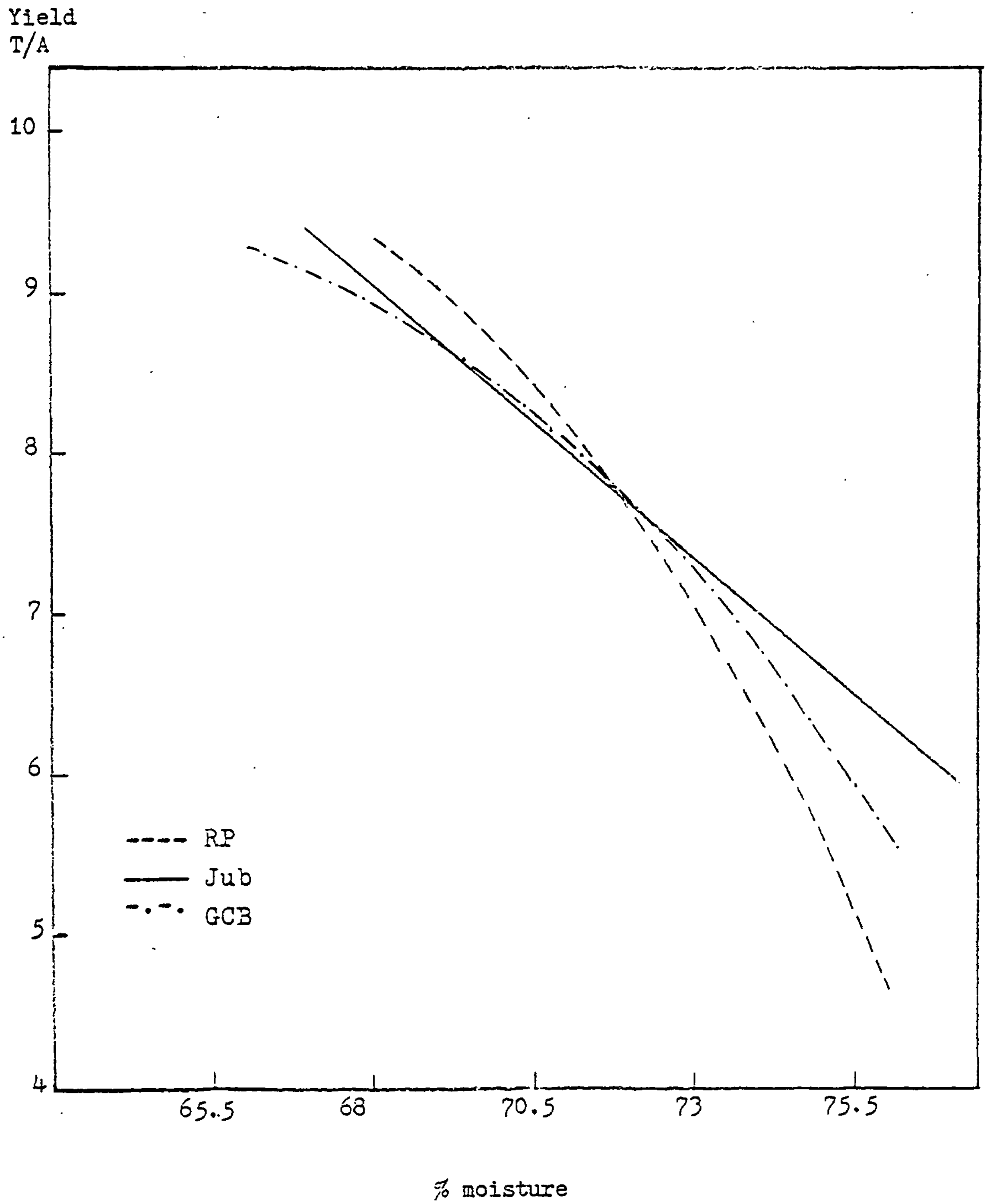


Fig 22. Regression of total sugar on per cent moisture content in kernels, curves adjusted to Jub at 72% moisture in 1976.

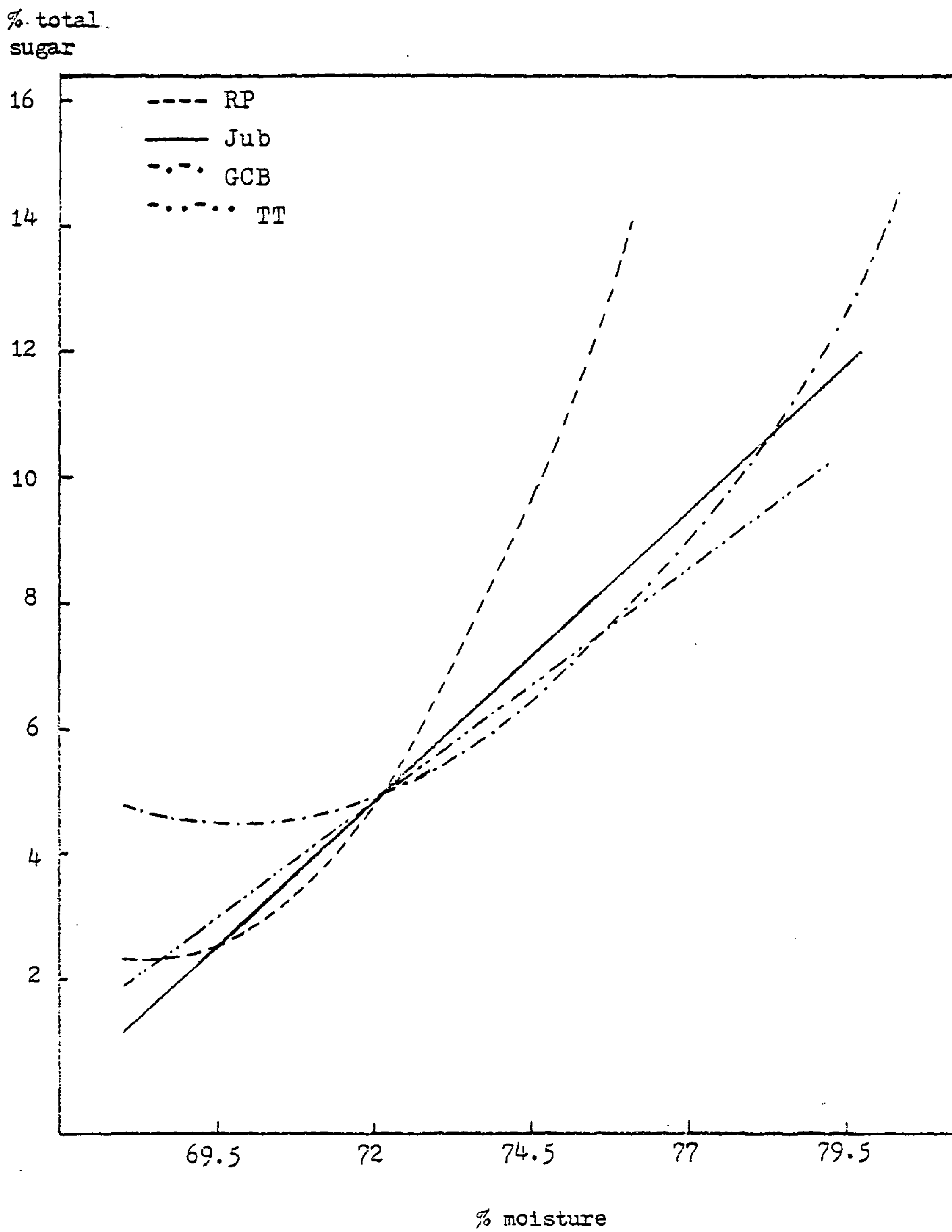


Fig 23. Regression of total sugar on per cent moisture content in kernels, curves adjusted to Jub at 72% moisture, 1977.

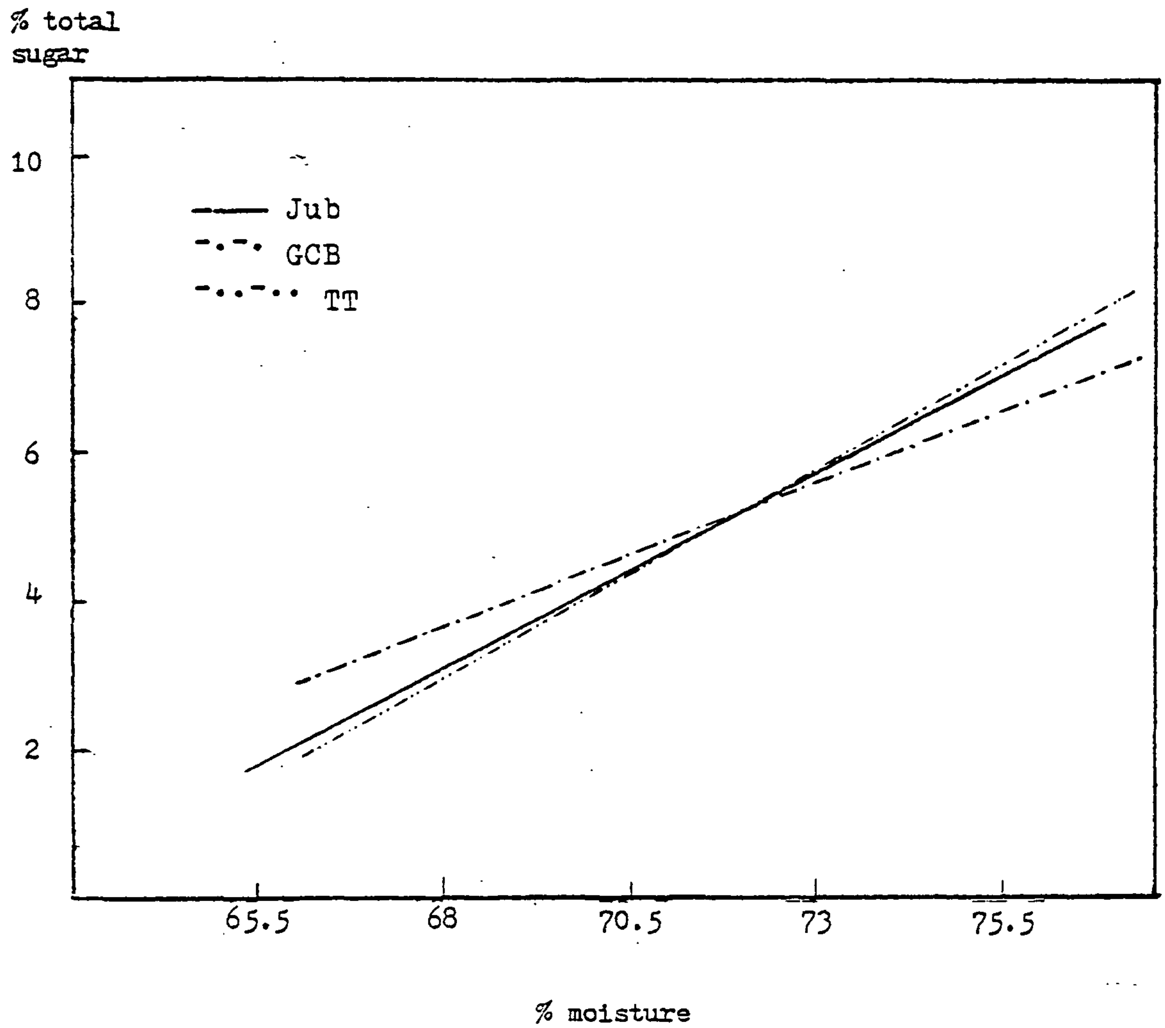


Table 12. Adjustment of yield and total sugar from the moisture content.

cultivar	moisture %	1976 adjusted yield	1976 adjusted total sugar	1977 adjusted yield	1977 adjusted total sugar
RP	78	3.93	23.00*	0.29*	-----
	76	4.33	15.90	2.29	-----
	74	4.73	10.50	3.95	-----
	72	5.13	6.75	5.29	-----
	70	5.53	4.67	6.29	-----
	68	5.93	4.26	6.97	-----
Jub	78	6.43	10.40	5.64	8.29
	76	6.78	8.57	6.32	7.25
	74	7.14	6.72	7.00	6.21
	72	7.49	4.86	7.68	5.17
	70	7.85	3.00	8.36	4.13
	68	8.20	1.15	9.04	3.09
GCB	78	4.04	10.30	0.91*	8.29
	76	4.32	7.67	2.26	7.52
	74	4.60	5.80	3.41	6.76
	72	4.88	4.66	4.35	6.00
	70	5.16	4.26	5.09	5.23
	68	5.44	4.60	5.63	4.47
TT	78	----	14.70	----	10.96
	76	----	13.20	----	9.86
	74	----	11.70	----	8.76
	72	----	10.20	----	7.66
	70	----	8.68	----	6.55
	68	----	7.17	----	5.44

---- no statistically significant relationship.

* Predictions are most accurate in narrow range and may be inaccurate or misleading at the lower and upper ranges.

yield and sugar concentration for each cultivar for each year. These adjustments show that 'Jubilee' had a higher yield and good quality at the same stage of maturity. 'Tendertreat' had the same yield characteristics as 'Jubilee', but at 72 % moisture the corn was too immature to give desirable body and quality. Higher sugar concentration that occurred at 72 % moisture in 'Tendertreat' may be due to slow rate of starch formation at this stage of maturity. It is recognized that adjustments or predictions made from these analyses are most accurate in a narrow range and that calculations may be misleading at the lower and upper ranges.

Several additional calculation made from these experiments, although they are not discussed here, may give further information for determining the merits of a sweet corn cultivar. These data are shown in Appendices.

V. SUMMARY AND CONCLUSIONS

The following summary and conclusions can be made from results of this study :

(1) Seasonal temperatures, through influence on the rate of development and maturing of sweet corn and to some extent the relative proportions of the different chemical constituents in the kernels, are important in determining the quality of sweet corn. High temperatures during the maturing of sweet corn appeared to hasten the rate of moisture and sugar loss of kernels.

(2) The number of days from planting to the time of silking in the two years ranged from 69 to 75 for 'Rapidpak', from 73 to 76 for 'Jubilee', 75 to 76 for 'Golden Cross Bantam' and 79 to 84 for 'Tendertreat' during 1977 and 1976, respectively. 'Rapidpak' was the first of the cultivars to reach the silking period of development and 'Tendertreat' was the latest of the cultivars to reach the silking period of development.

(3) Heat units (degree hours) were calculated from temperature data and from the correlation coefficients of regression there was no apparent increase in precision using the degree hours system compared to days from planting to predict optimum maturity.

(4) The yield of husked good ears increased by delaying harvest. 'Jubilee' produced the highest yield while 'Golden Cross

Bantam' produced the lowest yield. The increase averaged 0.135 tons per acre per day's delay in harvest for three cultivars in 1976 and 0.152 tons per acre per day in 1977. No evidence of linear or quadratic relationships between yield and harvest date was found for 'Tendertreat' because of erratic yields at various harvest dates. Further research is needed to clarify the maturation and yield relationships of 'Tendertreat'.

(5) The percentage of moisture in the developing kernels decreased continuously during the growth and maturation of the ears. Kernel moisture loss was found to be linearly or curvilinearly related to harvest date and degree hours. The moisture loss averaged 0.678 % for each day's delay in harvest in 1976 and 0.577 % in 1977. On a degree hours basis, 'Rapidpak' required 449 degree hours to decrease moisture loss in 260 degree hours. Degree hours of 334 and 316 were required to decrease moisture one per cent for 'Jubilee' and 'Golden Cross Bantam', respectively.

(6) The total sugar concentration in sweet corn kernels was beginning to decrease when sampling began. Total sugar decreased rapidly at first then slowed while reducing sugars decreased throughout as harvest date was delayed. Average percent total sugar decreased 0.589 % for each day of delay of harvest in 1976 and 0.304 % in 1977. Changes were affect -ed by different harvest dates and the prevailing temperature.

(7) Sucrose concentration dropped most rapidly at early harvest, then decreased slowly. Average sucrose concentration decline was 0.579 % for each day's delay of harvest in 1976 and 0.226 % in 1977. A 1:10 ratio of fructose to sucrose may be related to good quality of kernels because it correspond -ed with approximately 72 per cent moisture and 5-6 percent total sugar for the cultivars.

(8) There was a 0.173 tons per acre average increase of yield for each one percent drop in moisture content of kernels for three cultivars in 1976 and 0.264 tons per acre in 1977. Adjustment of yield was made from the moisture content in the study and indicated that 'Jubilee' had higher yield than other cultivars at 72 per cent moisture content of kernels.

(9) Regression estimates of total sugar on moisture reveal that corn quality is not the same for all cultivars at the same moisture level. Total sugar decreases averaged 0.589 % for each percent decrease in moisture content of kernels in 1976 and 0.304 % in 1977.

(10) Proper timing of harvest and selection of cultivars have to be made to achieve optimum yield and quality. Further study is needed, however, to better ascertain the optimum relationships between yield, moisture content, percent sugar, kernel content of other constituents, and careful quality evaluation for each cultivar.

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APPENDICES

Table 1. Cull yields and number of culls for four cultivars in 1976 and 1977.

		1976			1977		
cultivar	harvest date	un-husked wt lbs	husked wt lbs	No of culls	un-husked wt lbs	husked wt lbs	No of culls
RP	1	6.10	3.28	24	3.86	2.42	11
	2	7.68	4.40	29	6.36	4.00	17
	3	4.74	2.32	20	8,98	5.78	25
	4	8.06	4.40	34	8.54	5.70	22
	5	6.36	3.56	24	7.18	4.88	19
	6	5.42	3.74	16	6.48	4.36	18
average		6.39	3.62	24	6.90	4.52	19
Jub	1	11.60	7.14	34	4.26	2.68	12
	2	5.42	3.62	18	5.64	3.44	17
	3	8.12	5.04	29	7.42	4.70	20
	4	8.60	5.46	32	6.40	4.22	17
	5	8.88	5.82	36	7.58	4.76	20
	6	8.82	5.66	36	5.84	3.84	15
average		8.57	5.46	31	6.19	3.94	17
GCB	1	7.16	3.62	28	6.26	3.78	16
	2	4.64	2.48	18	4.80	2.70	13
	3	4.66	2.58	16	8.67	5.38	23
	4	5.74	3.16	25	8.87	5.05	22
	5	5.30	3.28	19	10.10	6.42	26
	6	4.56	2.58	16	11.20	7.30	28
average		5.34	2.95	20	8.32	5.10	21
TT	1	6.04	4.00	14	10.30	6.74	25
	2	6.86	4.56	17	8.64	5.50	22
	3	10.50	7.30	25	11.80	9.74	34
	4	13.00	9.34	29	16.30	11.20	34
	5	13.60	10.00	30	17.40	11.20	36
	6	14.40	10.50	31	16.30	11.10	35
average		10.70	7.62	24	13.50	9.25	31
total average		7.75	4.82	25	8.73	5.70	22

Table 2. Estimated yields of husked good ears for four cultivars at six harvest dates and average increase for each day of delay of harvest in 1976 and 1977.

	1976			1977		
cultivar	days	actual value tons/A	estimated value tons /A	days	actual value T/A	estimated value tons /A
RP	101	4.49	4.65	97	5.87	5.87
	103	5.00	4.89	99	6.18	6.33
	105	5.08	5.13	101	6.97	6.71
	108	5.67	5.49	105	7.14	7.21
	110	5.69	5.73	108	7.27	7.36
	112	5.84	5.97	111	7.38	7.32
average increase			0.12			0.135
Jub	103	5.86	6.27	97	6.85	6.91
	105	6.83	6.59	99	7.33	7.22
	108	7.11	7.06	101	7.47	7.54
	110	7.84	7.38	105	8.37	8.17
	112	7.62	7.70	108	8,36	8.64
	115	7.89	8.17	111	9.22	9.11
average increase			0.158			0.157
GCB	105	4.01	4.01	99	4.02	4.17
	108	4.47	4.39	101	5.13	4.87
	110	4.47	4.64	105	5.64	5.81
	112	5.00	4.89	108	6.35	6.14
	115	5.59	5.27	111	5.81	6.14
	117	5.31	5.52	113	6.13	5.95
average increase			0.126			0.164
TT	112	8.41	----	105	6.99	----
	115	7.89	----	108	6.92	----
	117	8.68	----	111	6.63	----
	119	8.06	----	115	7.30	----
	122	7.94	----	118	7.11	----
	124	8.24	----	120	7.71	----
three cultivars average increase			0.135			0.152

Table 3. Estimated values of moisture content in kernels for four cultivars at six harvest dates and moisture loss for each day's delay of harvest in 1976 and 1977.

	1976			1977		
cultivar	harvest date	actual value %	estimated value %	harvest date	actual value %	estimated value %
RP	101	74.9	74.4	97	71.1	70.7
	103	73.1	73.2	99	69.7	69.8
	105	71.5	72.1	101	68.2	68.9
	108	69.8	70.3	105	67.8	67.2
	110	69.9	69.1	108	65.4	65.8
	112	67.9	68.0	111	64.7	64.5
average loss			0.584			0.441
Jub	103	79.1	78.8	97	74.6	74.6
	105	77.6	77.1	99	73.5	73.2
	108	73.4	74.4	101	71.6	72.0
	110	72.7	72.7	105	70.2	70.1
	112	70.5	70.9	108	69.2	69.1
	115	68.9	68.3	111	68.4	68.5
average loss			0.881			0.436
GCB	105	78.6	77.9	99	72.8	71.8
	108	75.4	75.3	101	69.8	70.5
	110	73.6	73.5	105	67.5	67.8
	112	70.2	71.7	108	65.3	65.8
	115	68.2	69.1	111	64.1	63.8
	117	68.8	67.3	113	62.8	62.5
average loss			0.887			0.670
TT	112	79.4	79.5	105	79.1	78.9
	115	75.3	75.1	108	75.2	75.3
	117	72.9	72.6	111	71.9	72.4
	119	70.2	70.7	115	70.1	69.5
	122	68.7	68.6	118	68.3	68.1
	124	67.9	67.8	120	67.2	67.5
average loss			0.979			0.760
total average daily moisture loss of kernels			0.687			0.577

Estimated values are calculated from regressions.

Table 4. Per cent moisture content of kernels estimated from the degree hours and average loss per degree hour for four cultivars in 1976 and 1977.

	1976			1977		
cultivar	degree hours	actual value %	estimated value %	degree hours	actual value %	estimated value %
RP	31236	74.9	74.3	39660	71.1	70.6
	31824	73.1	73.2	40332	69.7	69.8
	32304	71.5	72.3	41004	68.2	67.1
	33480	69.8	70.1	42564	67.8	67.1
	33996	69.9	69.1	43500	65.4	65.9
	34512	67.9	68.1	44676	64.7	64.5
average loss			0.00189			0.00122
Jub	31824	79.1	78.9	39660	74.6	74.6
	32304	77.6	77.5	40332	73.5	73.2
	33480	73.4	74.0	41004	71.6	72.1
	33996	72.7	72.5	42564	70.2	70.0
	34512	70.5	70.9	43500	69.2	69.1
	35340	68.9	68.5	44676	68.4	68.5
average loss			0.00296			0.00122
GCB	32304	78.6	78.2	40332	72.8	71.9
	33480	75.4	74.8	41004	69.8	70.6
	33996	73.6	73.3	42564	67.5	67.6
	34512	70.2	71.8	43500	65.3	65.9
	35340	68.2	69.4	44676	64.1	63.7
	36132	68.8	67.2	45252	62.8	62.6
average loss			0.00288			0.00188
TT	34512	79.4	79.0	42564	79.1	78.8
	35340	75.3	75.8	43500	75.2	75.6
	36132	72.9	72.8	44676	71.9	72.2
	36876	70.2	70.0	45840	70.1	69.5
	37044	68.7	69.4	46632	68.3	68.1
	37572	67.9	67.4	47004	67.2	67.6
average loss			0.00379			0.00252
total average loss			0.00216			0.00171

Estimated values are calculated from regressions.

Table 5. Estimated values of total sugar concentration for four cultivars at six harvest dates and average decrease per day's delay of harvest in 1976 and 1977.

cultivar	1976 days	1976 actual value %	1976 estimated value %	1977 days	1977 actual value %	1977 estimated value %
RP	101	12.90	12.30	97	5.94	----
	103	8.55	8.95	99	3.70	----
	105	5.36	6.46	101	4.14	----
	108	5.17	4.39	105	3.35	----
	110	5.03	4.12	108	3.07	----
	112	3.97	4.73	111	4.35	----
average decrease			0.430			----
Jub	103	12.70	12.80	97	6.27	6.29
	105	9.65	9.35	99	6.10	5.82
	108	4.89	5.64	101	5.86	5.36
	110	4.72	4.11	105	3.18	4.44
	112	3.28	3.32	108	3.57	3.74
	115	3.48	3.54	111	3.72	3.05
average decrease			0.500			0.231
GCB	105	11.60	11.10	99	6.37	6.29
	108	5.71	7.24	101	5.23	5.39
	110	6.33	5.51	105	4.21	4.00
	112	4.74	4.43	108	2.99	3.30
	115	4.13	4.04	111	3.22	2.89
	117	4.39	4.60	113	2.64	2.79
average decrease			0.706			0.250
TT	112	15.00	14.90	105	11.00	11.00
	115	14.90	12.80	108	10.00	9.72
	117	9.76	11.30	111	8.47	8.43
	119	8.06	9.91	115	6.22	6.70
	122	7.94	7.76	118	4.87	5.41
	124	7.39	6.33	120	5.27	4.55
average decrease			0.720			0.430
total average decrease			0.589			0.304

--- due to no significant relationship between total sugar content and days.

Estimated values are calculated from regressions.

Table 6. Estimated values of sucrose concentration for four cultivars at six harvest dates and average decline per day's delay of harvest in 1976 and 1977.

cultivar	1976 days	1976 actual value %	1976 estimated value %	1977 days	1977 actual value %	1977 estimated value %
RP	101	10.20	9.72	97	5.02	----
	103	6.73	7.06	99	3.10	----
	105	4.22	5.12	101	3.43	----
	108	4.17	3.53	105	2.55	----
	110	4.09	3.36	108	2.27	----
	112	3.27	3.89	111	3.28	----
average decrease			0.707			----
Jub	103	8.69	8.67	97	5.05	5.09
	105	6.53	6.43	99	4.84	4.67
	108	3.54	4.03	101	4.76	4.24
	110	3.57	3.07	105	2.40	3.40
	112	2.55	2.64	108	2.53	2.76
	115	2.91	2.95	111	2.71	2.13
average decrease			0.670			0.211
GCB	105	8.11	----	99	5.15	5.11
	108	4.06	----	101	4.33	4.41
	110	5.07	----	105	3.39	3.26
	112	3.82	----	108	2.40	2.63
	115	3.31	----	111	2.44	2.20
	117	3.49	----	113	1.93	2.03
average decrease			----			0.220
TT	112	9.10	9.73	105	7.04	7.65
	115	10.50	8.65	108	7.69	6.92
	117	7.50	7.93	111	6.39	6.18
	119	6.05	7.21	115	5.00	5.19
	122	6.00	6.13	118	3.93	4.46
	124	5.92	5.41	120	4.31	3.96
average decrease			0.360			0.246
total average decrease			0.579			0.226

--- due to no significant relationship between sucrose content and days.

Estimated values are calculated from regressions.

Table 7. Estimated values of yield for four cultivars at different moisture content of kernels and average increase for each one percent moisture drop in 1976 and 1977.

cultivar	1976 moist content %	1976 actual value T/A	1976 estimated value T/A	1977 moist content %	1977 actual value T/A	1977 estimated value T/A
RP	74.9	4.49	4.54	71.1	5.87	5.78
	73.1	5.00	4.91	69.7	6.18	6.41
	71.5	5.08	5.23	68.2	6.97	6.91
	69.8	5.67	5.57	67.8	7.14	7.01
	69.9	5.69	5.55	65.4	7.27	7.35
	67.9	5.84	5.96	64.7	7.38	7.36
average increase			0.202			0.247
Jub	79.1	5.86	6.23	74.6	6.85	6.79
	77.6	6.83	6.50	73.5	7.33	7.17
	73.4	7.11	7.24	71.6	7.47	7.81
	72.7	7.84	8.37	70.2	8.37	8.29
	70.5	7.62	7.76	69.2	8.36	8.63
	68.9	7.89	8.04	68.4	9.22	8.90
average increase			0.177			0.340
GCB	78.6	4.01	3.95	72.8	4.02	4.00
	75.4	4.47	4.39	69.8	5.13	5.16
	73.6	4.47	4.65	67.5	5.64	5.73
	70.2	5.00	5.12	65.3	6.35	6.03
	68.2	5.59	5.41	64.1	5.81	6.09
	68.8	5.31	5.33	62.8	6.13	6.07
average increase			0.141			0.204
TT	79.4	8.41	----	79.1	6.91	----
	75.3	7.89	----	75.2	6.92	----
	72.9	8.68	----	71.9	6.63	----
	70.2	8.06	----	70.1	7.30	----
	68.7	7.94	----	68.3	7.11	----
	67.9	8.24	----	67.2	7.71	----
average increase			----			----

--- due to no significant relationship between yield and moisture content of kernels.

Husked good ears yield is used here.

Estimated values are calculated from regressions.

Table 8. Total sugar content estimated from the moisture content of kernels and average decline for each one percent drop in moisture content of kernels for four cultivars in 1976 and 1977.

cultivar	1976 moist content %	1976 actual value %	1976 estimated value %	1977 moist content %	1977 actual value %	1977 estimated value %
RP	74.9	12.30	12.70	71.1	5.94	----
	73.1	8.55	8.62	69.7	3.70	----
	71.5	5.36	6.10	68.2	4.14	----
	69.8	5.17	4.58	67.8	3.35	----
	69.9	5.03	4.63	65.4	3.07	----
	67.9	3.97	4.31	64.7	4.35	----
average decline			1.20			----
Jub	79.1	12.70	11.40	74.6	6.27	6.53
	77.6	9.65	10.10	73.5	6.10	5.95
	73.4	4.89	6.16	71.6	5.86	4.96
	72.7	4.72	5.51	70.2	3.18	4.24
	70.5	3.28	3.47	69.2	3.57	3.72
	68.9	3.48	1.98	68.4	3.72	3.30
average decline			0.928			0.520
GCB	78.6	11.60	11.20	72.8	6.37	6.30
	75.4	5.71	7.03	69.8	5.23	5.16
	73.6	6.33	5.51	67.5	4.21	4.28
	70.2	4.74	4.26	65.3	2.99	3.44
	68.2	4.13	4.53	64.1	3.22	2.98
	68.8	4.39	4.37	62.8	2.64	2.49
average decline			0.697			0.381
TT	79.4	15.00	15.80	79.1	11.00	11.60
	75.3	14.90	12.70	75.2	10.00	9.42
	72.9	9.76	10.90	71.9	8.47	7.60
	70.2	8.06	8.91	70.1	6.22	6.61
	68.7	7.94	7.70	68.3	4.87	5.62
	67.9	7.39	7.10	67.2	5.27	5.01
average decline			0.755			0.551
total average decline			0.892			0.484

--- due to no significant relationship between sugar concentration and moisture content of kernels.
Estimated values are calculated from regressions.

Table 9. Determinations of moisture content of sweet corn from frozen samples using different methods for four cultivars in 1976 and 1977

		1976		1977
cultivar	harvest date	vacuum oven method	micro -wave method	freeze drier method
RP	1	78.6	78.0	73.2
	2	76.7	76.1	73.4
	3	76.7	75.3	70.9
	4	73.2	72.2	69.8
	5	72.5	71.1	68.3
	6	71.2	70.1	66.5
Jub	1	83.0	81.3	78.7
	2	81.4	79.7	76.6
	3	77.3	75.8	74.0
	4	76.0	74.7	72.5
	5	72.9	72.1	70.2
	6	72.9	71.4	69.9
GCB	1	83.1	81.4	75.5
	2	78.8	78.5	73.2
	3	77.3	77.2	69.8
	4	75.0	72.6	68.1
	5	71.6	70.6	66.2
	6	70.5	69.8	65.4
TT	1	82.3	81.2	80.0
	2	78.4	77.8	76.0
	3	74.9	72.5	74.0
	4	75.6	74.4	71.7
	5	72.5	71.3	71.7
	6	72.9	71.0	70.3

Table 10. Estimate of relations among some attributes of sweet corn.

cultivar	regression of kernel yield on days	r	regression of yield on kernel yield	r	regression of yield on total sugar	r
			1976			
RP	-99.4 + 0.121X	.921**	2.61 + 0.915X	.930**	---------------	NS
Jub	--------------	NS	-9.56 + 7.05X - 0.71X	.986**	8,41 - 0.19X	.935**
GCB	-130.6 + 2.28X - .0097X	.938*	12.5 - 7.26X + 1.56X	.949*	9.28 - 1.18X + 0.062X	.984**
TT	--------------	NS	-------------	NS	---------------	NS
			1977			
RP	--------------	NS	2.62 + 2.10X - 0.236X	.979**	---------------	NS
Jub	-218 + 4.08X - 0.0187X	.968**	5.23 + 0.622X	.876*	-1.15 + 4.74X - 0.553X	.955*
GCB	-23.5 + 0.255X	.909*	--------------	NS	7.80 - 0.588X	.961**
TT	-21.9 + 0.24X	.914*	13.5 - 3.38X + 0.39X	.989**	---------------	NS

continued

cultivar	regression of yield on % sucrose	r	regression of % sucrose on % moist	r	regression of % total sugar on % sucrose	r
			1976			
RP	6.28 - 0.181X	.900*	798 - 23.2X + 0.169X	.987**	-0.064 + 1.27X	.999**
Jub	8.56 - 0.296X	.930**	344 - 9.76X + 0.07X	.996**	-0.83 + 1.57X	.999**
GCB	9.70 - 1.69X + 0.123X	.939*	-22.7 + 0.377X	.858*	-0.99 + 1.54X	.994**
TT	--------------	NS	-19.3 + 0.37X	.848*	-2.83 + 1.78X	.965**
			1977			
RP	--------------	NS	--------------	NS	0.653 + 1.05X	.988**
Jub	-3.08 + 7.32X - 1.07X	.934**	-29.8 + 0.471X	.893*	0.654 + 1.11X	.998**
GCB	7.57 - 0.632X	.942**	-18.9 + 0.332X	.991**	0.333 + 1.15X	.998**
TT	--------------	NS	-15.9 + 0.301X	.880*	-1.58 + 1.61X	.964**

* significant

** highly significant