A STUDY OF CERTAIN MORPHOLOGICAL CHARACTERS IN RED CLOVER POPULATIONS

by

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THESIS

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INTRODUCTION

Red clover, recognized as the corner stone of agriculture, is one of the most widely distributed of all cultivated clovers.

The production of red clover and other forage crop seed in Canada today is a very important business and various organizations are interested in the different phases which allow the farmers to obtain good material for seeding. Among those organizations the Canadian Forage Seeds Project must be mentioned.

The Canadian Forage Seeds Project was organized in 1952, and its purpose is to make available to the growers of forage crops pedigree seed of improved varieties of these crops. Practically, it is the function of the Canadian Forage Seeds Project to devise a scheme whereby new and improved varieties can be multiplied rapidly and surely and the seed made available to the growers in quantities sufficient to meet their needs.

Four classes of pedigree seed are recognized in forage crops, Foundation, Approved, Registered and Certified.

Since the initiation of the Canadian Forage Seeds Project the production of pedigree seed has been undertaken in the following species and varieties: red clover, Lasalle; alfalfa, Grimm and Vernal; sweet clover, Erector; timothy, Climax and Medon; crested wheat, Summit. The five different kinds of crops included represent those that are most commonly grown in Canada.

In the case of red clover in which we are mainly interested, the Canadian Forage Seeds Project aimed to multiply seed in the Prairie Provinces.

Not only is there ample space for isolation but experience indicates that there is less likelihood of winter-killing and seed yields are much higher than in most parts of the East.

Red clover seed production is also under considerable study in the United States. The National Foundation Seed Project has been in operation since 1948, and is concerned with the same type of problem to which the Canadian Forage Seeds Project was facing. The purpose of the U.S. organization, then, is to make available to the growers of forage crops pedigree seed of improved varieties of these crops. So, the National Foundation Seed Project has been an important factor in the production of the large quantities of certified Kenland that is now available to U.S. farmers.

Every variety or strain of red clover is made up of plants that vary widely in type, maturity, resistance to diseases and yielding ability. There are no pure or true-breeding strains such as we have in cereal grains, which are self-fertilized. Red clover produces seed by cross-fertilizing. This genetic character favors the development of a great variety of ecotypes and biotypes of the two forms, doublecut and singlecut, according to Hollowell (1940). This variability in type is facilitated because red clover, being for all practical purposes self-sterile, is constantly hybridizing.

In order to maintain the productive punch of the variety all the producing types must be maintained in the proportions built into the variety by the plant breeder. Consequently, the regulations for pedigree seed specify that the seed must be taken in the second

vegetative year of a stand for carrying all the original types in the same proportion as the original seed.

The problem of changes or alterations within a variety has been touched in a preliminary investigation undertaken at Macdonald College in 1953, by Steppler and Raymond (1954).

In the fall of 1952, a fortuitous harvest of Lasalle seed in the year of seeding, made by a western farmer, gave the first real opportunity to study the effect of this management practice: harvesting the seed in the year of seeding. This lot was tested in 1953, against Dollard. The latter variety is constituted so that it contains approximately 75% of Types II and III and the remaining 25% of 0, I and IV. This system of type classification had been originated by Bird (1948) and referred to the growth in the year of establishment.

Studied as spaced plants, this Lasalle seed lot, designated as lot X, showed a marked deviation from the expected norm (Dollard). Seed lot X had a much higher percentage of Type IV than is found in Dollard. This is illustrated by Diagram 1 (page 19). According to Steppler and Raymond (1954) who made those observations, "the deviation from the expected is so great that it is not likely due to chance variation and hence it seems reasonable to attribute it to the practice of taking seed in the year of seeding. Certainly the conditions under which the seed was produced - whether due to climate, management or a combination of them - very definitely altered the stock from the expected percentages".

From those preliminary observations, a more elaborate project

was set up in order to investigate the deviation, or the change in composition of plant types, from the expected norm (Dollard). Some morphological characters were selected and studied, during the seeding year, in regard to Dollard. Those tests were conducted on samples of Lasalle, provided by Ottawa in connection with the Canadian Forage Seeds Project. In addition to Lasalle, and following the same line of research, samples of Kenland representing different seed stocks, were included in the test. However Kenland breeder stock was selected as the standard or the norm instead of Dollard. Also, several local strains of red clover from various parts of the province of Quebec were obtained from farmers and included in our investigation.

REVIEW OF LITERATURE

A very extensive literature review has been done by Bird (1948), when he gave the description of the five different types of red clover that he had distinguished within a variety. Referring to this basic work, the most important papers will be mentioned and the earliest papers published in the same line will be added.

According to Bird (1948), one of the first comprehensive studies of types within red clover has been made by Williams (1927) at the Welsh Plant Breeding Station. This worker, in a very extensive investigation on red clover, classified all strains that he had under observation into three main groups: (1) Lates; (2) earlies; (3) wild. These three groups differed not only as regards their botanical characters, but also to an even more marked degree in respect to their cropping capacities, persistency and other agronomic characters. The late clovers had a more or less dense, tufted and prostrate habit of growth, in the spring and early summer. They tend to become more erect as they mature, but they retained their characteristic spreading habit of growth even when in bloom. They tillered freely and their stems were long, comparatively slender and more or less solid up to the time of flowering, when they all tend to become fistular. They had also a relatively large number of internodes and side branches. Generally, they made comparatively slow growth and flowered only sparingly in the seeding year unless sown early. Before the winter set in, they formed dense leaved rosettes in which semi-dormant stage they remained until late spring. They were from two to four weeks later than the earliest in starting active growth

in the spring and in coming into bloom. In general, they were not very productive in the seeding year, unless sown early. However, they gave heavy crops of hay and fairly good aftermath crops provided the hay was mown early. From the farmer's standpoint, one of the most outstanding features of the late red clovers is the fact that they were able to hold the ground well into the second year and possibly into the third and fourth year on suitable land. They were also able to withstand heavy grazing better than the early red clovers.

In comparison with the late clovers, the earlies had a more erect and more open growth, the stems were fewer, shorter, stouter and more fistular and had fewer internodes and side branches. They were about 14 to 28 days earlier in starting active growth in the spring and in flowering. They were capable of producing two full crops of bloom annually. Although achieving more growth during the year of seeding, the earlies were less productive in the first harvest year than the lates. Although differing greatly in their ability to overwinter, none of the earlies was able to hold the ground well into the second year.

The indigenous wild red clovers exhibit a much wider variation as regards their morphological and agronomic characters than even the most variable of the cultivated varieties. Generally speaking, they were very small with slender hard stems which were pratically solid even when in flower, and much more pubescent than the European strains of commerce. They were highly variable in regard to time of flowering; but most of them bloomed very early, several weeks before the earliest of the cultivated varieties. They had a very short

growing season and they did not start active growth as early in the spring as did the cultivated varieties and they produced comparatively little aftermath. They were more persistent than the earlies, and they appeared to hold the ground in the third year. But the wild red clover was not as productive as the late clovers in the first two years.

More recently, Hawkins (1953) working at Cambridge published a paper in which he suggested a method of identifying three main types which were classified as follows: (1) Broad red, doublecut or early flowering red clover; (2) singlecut red clover, singlecut cowgrass or English late flowering red clover; (3) late flowering red clover. In addition, he mentioned two other intermediate types: (1) medium-early, being intermediate between broad and singlecut; and (2) medium late, being intermediate between singlecut and late-flowering.

According to Hawkins (1953) the types of red clover can be distinguished by differences in the time of flowering and also by differences in the number of internodes on the main stem when in flower. Identification of the five types by means of differences in the number of internodes on the flowering main stems was found to be more exact and easier in practice than identification by means of differences in flowering time. Experiments were carried out in 1931 and in 1951 in which the number of internodes per flowering main stem, the length of the main stem and the flowering date of stocks of various strains of the three main types of red clover were determined. He found also that there is considerable overlapping in the time of flowering of the different types, so that it is of limited value for distinguishing between crops of different types growing in the field. Even when grown

in a trial ground, single spaced plants must be used to establish differences of a week or less. A very close association between the time of flowering and the number of internodes on the main stem was also noticed; but the correlation between each of these characters and the length of the main stem is not so close. Hawkins added that the differences in the number of internodes on the main stem enable the different types to be distinguished with precision and this method has many advantages compared with recording the time of flowering, namely: the number of internodes does not increase once a bud has formed; they can be counted at any time during the ensuing four or five weeks following the time of flowering; all the plants can be examined on the same day and the number of internodes recorded; the plants do not have to be inspected two or three times a week for a period of four or five weeks as in the case when the time of flowering is recorded. Also, the number of internodes is a more definite character to record than many others but certain precautions are necessary. The number of internodes is counted from the bottom of the stem to the flower head or bud, and the following precautions must be taken if reliable figures and consistent results are to be obtained;

1. All stems must have formed a bud or flower before the internodes are counted.
2. Count the internodes on the main stem.
3. The lower internodes on some stems are very closely crowded together and it is impossible to count these accurately. Hawkins concluded that the mean number of internodes may be used as a basis for classifying strains of red clover.

In 1954, Hawkins studied strains of doublecut red clover and

gave more emphasis on the colour of flowers as a basis for classifying strains of red clover. The technique of measuring the colour of red clover flowers has been examined by Hawkins (1954) and also the value of this character for classifying different strains of red clover. He concluded that this character and the technique adopted for recording it is satisfactory. But as it was noticed earlier in his works, it is always wise to use as many characters as possible and not to rely on only one.

In Russia, the types of red clover have been investigated by Lissitzyn (1933) and Lisicyn and others (1935). No sharp demarcation or division of clover types was found between the early and late cultivated types. The late clovers were less leafy, coarser, unable to form aftermath (two-cut habit), and on the other hand, the early clovers were considered to be two-cut or to be able to form aftermath. The late type had more internodes and greater resistance to winter than the early. No relation was found between early habit and winter resistance.

A hypothetical classification was suggested by these Russian workers and based upon the formation of rosettes. All red clovers were then divided into three groups:

(1) Typical annual, without rosettes, early flowering, delicate, rare in occurrence.

(2) Not typical perennial, with weakly developed rosettes and little adapted to winter, including both early and late forms.

(3) Typical perennial, with strongly developed rosettes including both early and late forms. The authors underline the fact that the

populations of cultivated clovers which are usually found are complicated hybrid mixtures of these forms.

Other Russian workers, Gupalo et al. (1950) and Gupalo (1953) reported the results of their studies on the growth changes in sowings and on the physiological characteristics of morphobiotypes of red clover. The only source of information available about these studies is "Herbage Abstracts". In their first studies, Gupalo and others (1950) investigated the cause of lower seed yields obtained from red clover plots in the third year of growth compared with the second. They found that, under controlled conditions, the differences in physiological characteristics shown by plants in the third year, compared with those in the second, were attributed to aging, which resulted in a lower seed yield in the third year. In conclusion, they recommended collecting seed of late-ripening or one-cut clover from the third year stand so as to obtain plants which are more persistent and winter hardy. In his other paper, in referring to Lisicyn (1935) who had described three basic forms of red clover, namely: (1) spring annuals; (2) spring overwintering types; (3) winter plants, Gupalo (1953) investigated red clover strains in order to establish the degree of winter hardiness and persistency of red clover plants which flower in the first year compared to true winter plants. Working at Krasnoufimsk, he started his experiments under controlled conditions in culture vessels up to the second leafstage, after which the seedlings were planted out in the field on June 19. On September 15, all the populations had a percentage of flowering specimens of 30 to 35%, and there was a high percentage with non-flowering long stems, about 32 to 52%. Among all the types, the rosette plants (winter type

of development) comprised only 16 to 20%. It was concluded by Gupalo and his coworkers:that the flowering forms are physiologically older and have obtained a higher level of ontogenetic development than the rosette plants.

The types of Norwegian red clover have been investigated by Wexelsen (1938). Both wild and cultivated forms occur in Norway; but much of the red clover commonly found growing wild proved to be cultivated clover. Wexelsen (1938) described the different types which closely resembled the British and Russian types. In contrast with the well developed rosettes of late red clover, the early type formed only weak rosettes or none at all. There was also considerable variation in rosette formation and time of blooming. Wexelsen noticed that the time of planting or sowing and natural length of day had a marked influence upon the development of rosettes in the planting year.

In Sweden, Nilsson (1940), in making comparison of early and late types of red clover, drew attention to the fact that there was no sharp delimitation between early, medium and late red clover. Also, he mentioned that as early as 1909, Witte pointed out that quite considerable differences could be established in development in Swedish clover strains and that transition existed from the earliest of all to the latest of all. It seems, therefore, that the first grouping into late, early, medium-early strains has been done by Witte. On account of the variation within individual strains earliness and lateness could be altered by selection when seed was produced by different techniques, as pointed out by Hellbo (1940).

Julen and Nilsson-Leissner (1945), studying the influence of

environment on morphological development of red clover suggested that under different environmental conditions, climate has a great influence on external development. Under damp and cloudy conditions a vigorous green mass is developed and the course of flowering proceeds more slowly.

In New Zealand, Levy and Davies (1930) have classified red clover strains on a basis similar to that used by Williams (1927), in Great Britain. Most of the red clover grown in New Zealand was of early type or broad red. But red clover surveyed as a species in New Zealand was grouped under four main classes: (1) broad red; (2) late red; (3) extra late red; (4) wild red clover. Levy and Davies described the types as follows:

1.- Broad red clover. This type is also called early-flowering red clover, cow-grass and doublecut cow-grass. The broad red group is the least persistent of all the red clovers; it grows rapidly from seed and tends to produce excessive smother during the early growth periods. This early smother by broad red is certainly limiting the use of red clover in many parts of New Zealand, where the successful establishment of permanent grass is the objective, and where it is therefore essential that excessive smother by any one species shall not take place. Broad red clover flowers earlier in the season than late red clover but normally little or no seed is set in the early part of the season, due largely to the absence of bumble bees at this period. A second crop of flowers is produced in early autumn, when seed is set in abundance, and it is at that time that the seed crop is taken in practice. The average type of plant common in broad red clovers is typically lax at the crown at all stages of growth,

relatively few-tillering and producing stem rather than leafy growth, especially at mid-season. This inherent laxity in growth form of the plant in broad red becomes apparent in quite early seedling stages, and can at that time be made use of as one of the diagnostic characters distinguishing the broad from the late-flowering red clovers. New Zealand red clover is characteristically a broad red clover.

2.- Ordinary late-flowering red clover. Ordinary English late, Swedish late, Danish and other North European and North American lates comes into this group. A few plants in some lines of New Zealand red clover can probably be best placed in this group, but on the whole the New Zealand's red clover is typical broad red. Late red clover normally flowers rather later in the season than broad red and is more persistent, lasting two or three seasons in Britain as against one to two seasons in the case of the broad red. Late-flowering red clover plants when studied individually are fairly dense at the crown, and tiller better than the broad reds. Normally only one full crop of bloom is produced per annum. If allowed to mature at mid-season a second crop of flowers is not produced; but if grazed late into spring the flowering period is delayed, and this course is the normal practice when the crop is grown for seed. The leafy rather than stemmy aftermath makes late-flowering red clover a better grazing plant than broad red from mid-season onwards.

3.- Extra late-flowering red clover. There are two well-defined commercial strains belonging to this group -- the true Montgomery and the true Cornish Marl red clovers. Both of these are British local varieties, the former long cultivated in the Welshpool district of Montgomeryshire on the English-Welsh borders; Cornish Marl is similarly

largely localized to the Wadebridge district of North Cornwall. These varieties are closely allied the one to each other. Extra late red as a group is considerably more persistent then either of the two first groups discussed and is a more promising pasture type for New Zealand conditions. The type is slower to establish from seed than either broad or ordinary late red, and therefore does not produce that rapid flush of seedling growth so characteristic of the former. Only one crop of flowers is produced during the year.

4 - English wild red clover. Seed of this type is commercially available in England to a limited extent. It is there indigenous to very old grasslands, but the type does not appear to have reached New Zealand in any quantity -- at least, it has not become established as a constituent of old pastures in this country. As might be expected, wild red clover is an exceedingly heterogenous group. As a whole the type is low in total production and extremely variable in time of flowering, persistency, growth-form and leafiness. Many of the forms tend to be very dense though diminutive plants, and it may be possible to isolate types to fill special requirements as, for example, for use on hard sheep-country. It may also well be that very highly persistent forms of wild red exist and that these can be used for crossing with cultivated varieties with a view to increasing the persistency of the latter.

In the United States, Westgate and Hillman (1911), Pieters (1928) and Hollowell (1940) recognized as the two main groups of cultivated red clover, the early or doublecut and the late or single-cut type. The former is referred to as ordinary red clover by Westgate and Hillman, while very often it is called medium red. The singlecut

type is known as Mammoth in America. To make easier the distinction between agronomic forms of the early and late type, Hollowell (1940) proposed a classification based upon pubescence and origin. So, he divided the red clovers into four general groups: (1) European doublecut; (2) American doublecut; (3) European singlecut; (4) American singlecut. Although the seeds of these were indistinguishable, the plants of each might be identified readily if grown to maturity.

Chmelar and Mostovoj (1932), in Czechoslovakia found a technique for distinguishing single and doublecut red clover by growing it under artificial light. As different varieties and different plants of the same improved or only slightly improved variety of red clover (Trifolium pratense) do not possess the same photoperiodism, it is not possible to include all species of red clover in the group of long-day plants. Most plants of an early or doublecut and "perennial"variety showed under continous light more rapid development, with stem formation and later flower formation. The late or singlecut forms developed only leaves.

The technique is as follows: seeds are germinated for 32 hours in wet filter paper at 20°C and are then planted in trays filled with garden soil, spaced 2 x $\frac{1}{2}$ cm. apart. During the day, the plants are exposed to daylight, and from dusk until 8:00 a.m. they are subjected to electric illumination from two 200 Watt bulbs. Between the lamps and the plants a pan was placed with a glass bottom, through which water $1\frac{1}{2}$ cm. deep was allowed to flow. The top of the plant was, in the experiment described, kept 5cm. from the bottom of the pan and the water surface was 15 cm. below the filament of the bulb.

Late varieties show only vegetative growth after 15 days continous light while most of the plants of the early varieties formed stems and, after 30 days, even flowers.

In Canada, Bird (1948) seems to be the first to have made a comprehensive study of types within a selection of an improved strain. However, Malte (1921) had published a paper in which he suggested that red clover could be classified into: (1) Botanical varieties; (2) Biological varieties; and (3) Geographical varieties.

Under botanical varieties, Malte (1921) distinguished two types: (1) wild red clover; and (2) cultivated red clover. He also pointed out that this classification is very artificial and useless for Canada, because red clover is not indigenous to Canada.

From a biological point of view two main groups of varieties were mentioned: (1) early varieties; and (2) late varieties. As the names indicated, the two groups differed from each other in respect to the time required to reach full development, there being several weeks difference in the time of blossoming between the extreme early varieties and the extreme late varieties. The real difference, according to Malte (1921) was in the mode of growth and development in general rather than in earliness or lateness. The early red clover had few branch stems, only two to four in number and reaching the same height as the stem itself. The heads were all borne at about the same level. The late red clover had their stems more branched, generally from four to six in number, but not reaching full development at the same time. They did not attain the same height as the main stem and the flowering heads were not at the same level. The early has the

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faculty of producing a vigorous second growth, for the reason that after cutting it develops a second set of quick growing shoots. The late lacks the faculty of producing more than one set of shoots in a season. As a result it produces a comparatively scant aftermath after cutting and so a lower yield.

According to Malte (1921), red clover can also be classified from a geographical standpoint. Red clover is commonly listed by the trade, and referred to in experimental work, under names which simply signify the source of production of the seed. For example, Italian, or Russian, or French or American red clover can be obtained on the market. This way of designating red clover is of great importance, because comparison between local and foreign seed can be made easily.

Bird (1948) was the first to make a type classification of the variety Dollard, which along with the absence of the leaf-marking characteristic provided a good basis for verification of red clover populations. Bird (1948) has distinguished five types of plants based on the vegetative growth in the year of seeding. These five growth types are shown in Figures 1 to 5. They were described by Steppler and Raymond (1954) with reference to the growth in the year of establishment:

Type 0- produces rosette only; no flower formation (Fig.1)

Type I- produces strong rosette with one or a very few flower stems, prostrate (Fig.2)

Type II- produces fairly prominent rosette with a ring of flower stems, prostrate (Fig.3)

Type III- produces indistinct rosette with many flower stems, generally

upright (Fig. 4)

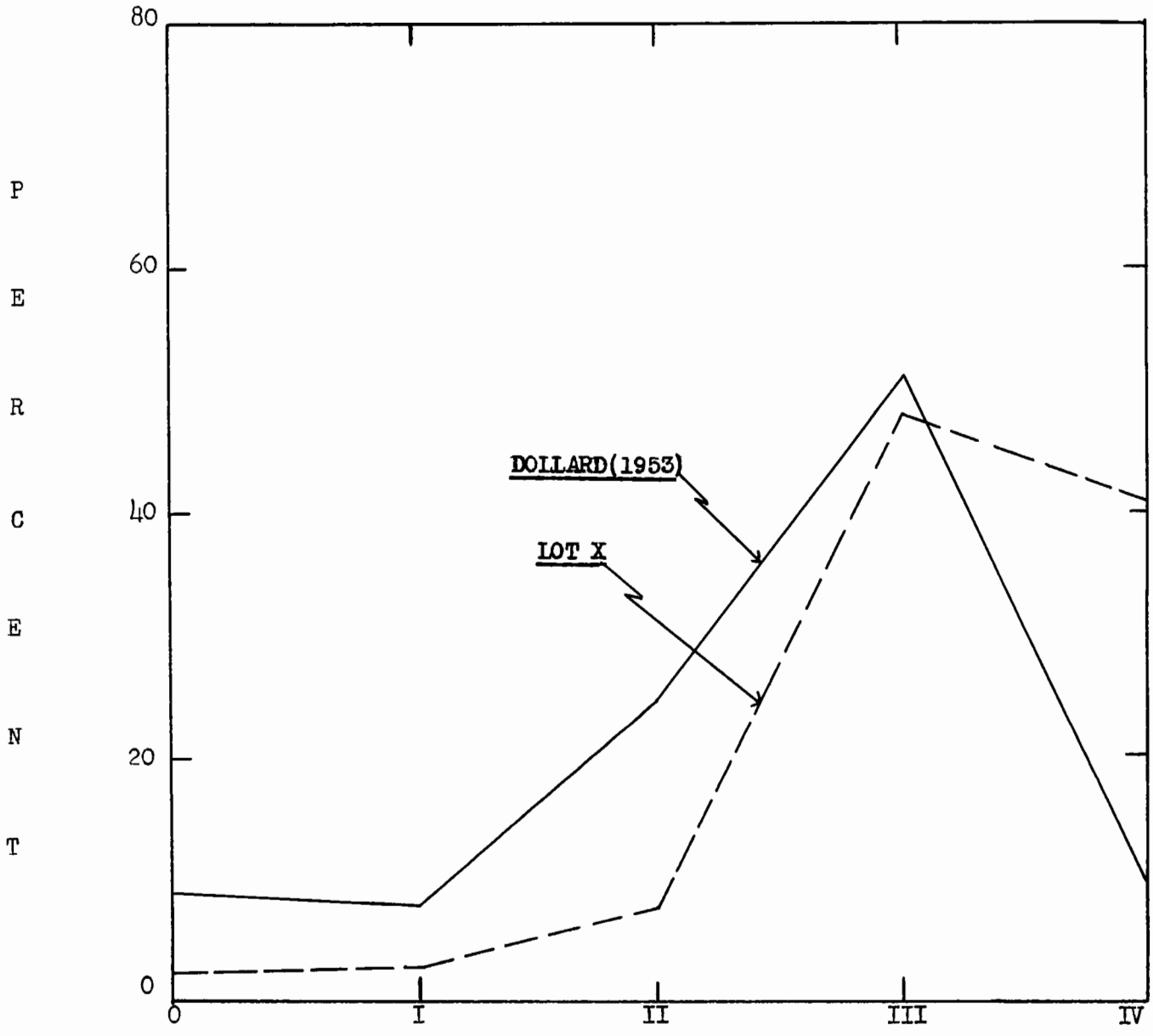
Type IV- produces no rosette, many sparsely leaved upright flower stems. (Fig. 5)

This classification was first applied to Lasalle material by Steppler and Raymond (1954). According to this classification, it seems possible to produce seed on Types III and IV in the year of seeding. However the normal practice in Eastern Canada is to seed red clover with a nurse-crop, i.e. oats, which is harvested as grain. The seed is harvested in the second year, where the second growth is allowed to produce seed.

According to Steppler and Raymond, a fortuitous harvest of seed in the year of seeding made by a western farmer provided the first real opportunity to study the effect of this management practice, which is the harvesting of seed in the year of seeding, when used on a farm scale. They classified 212 seedlings from the year-of-seeding stock, designated as lot X and coming from a field seeded with Lasalle red clover, and 792 seedlings of Dollard. Dollard is constituted so that it contains around 75 per cent Types II and III and 25 per cent Types 0, I and IV. Ottawa is expected to perform similarly. Lasalle was licensed in 1952 and originated by blending together equal quantities of the two varieties Dollard and Ottawa.

They reported that seed lot X had a much higher percentage of Type IV than found in Dollard. These workers came to the conclusion that the percentages found in lot X differed so markedly from the expected that it would not likely be accepted as representing the variety Lasalle. They attributed this difference in percentage type

DIAGRAM. 1 - LOT X COMPARED TO DOLLARD (1953), MACDONALD COLLEGE.



to the practice of taking seed in the year of seeding. They also added that certainly the conditions under which the seed was produced -- whether due to climate, management or a combinaison of both -- very definitely altered the stock from the expected percentages. Their observation for several years at Macdonald College indicated that plants which produce flowers and mature seed in the year of seeding usually do not survive the first winter.

In Diagram 1, the data reported by Steppler and Raymond were plotted, the two curves differ markedly, as far as Types II and IV are concerned. But from these preliminary data on one lot tested in one season, it was difficult to generalize and draw sound conclusions.

Fig. 1 Type O - produces rosette only; no flower formation.

Fig. 2 Type I - produces strong rosette with one or a very few flower stems, generally prostrate.

Fig. 3 Type II - produces fairly prominent rosette with a ring of flower stems, prostrate.

Fig. 4 Type III - produces indistinct rosette with many flower stems, generally upright.

Fig. 5 Type IV - produces no rosette. Many sparsely leaved upright flower stems.

Fig. 6 General view of range 35 (Lasalle and Kenland), July 21, 1954.

MATERIAL AND METHODS

MATERIAL

As basic material, samples of seed produced at 46 separate localities were obtained from four different sources.

First, 24 samples were obtained from farmers in different parts of the Province of Quebec through the kind co-operation of Agronomes. These formed quite a good sampling of what is cultivated throughout the Province, including as they did, interesting samples from the Gaspe region, the Lower St-Lawrence district, the Eastern Townships, the Montreal region and Gatineau region. A questionnaire was included with the requests for seed samples, and the information thus obtained made it possible to classify the samples as to location of origin and the number of years grown on the same farm.

Secondly, 11 samples were obtained through the Central Experimental Farm, comprising Ottawa, and the new variety Lasalle.

Thirdly, 10 samples of Kenland, representative of Breeder, Foundation, Registered and Certified stocks were received from the United States Department of Agriculture, sent by Dr E.A. Hollowell. The name of the state where each had been produced was given.

Finally, a sample of Dollard was received from Macdonald College.

The various strains, for classification and further reference, will be grouped under three headings:

1.- Quebec Strains (unnamed local strains) Table 1 and 2.

2.- Canadian Strains (Dollard, Ottawa and Lasalle) Table 3.

3.- U.S. Strains (Kenland) Table 4.

TABLE 1. CLASSIFICATION OF THE QUEBEC STRAINS ACCORDING TO PLACE OF PRODUCTION.

REGION	STRAIN No.	LOCALITY	NAME OF GROWER
	1	Charlevoix (St-Urbain)	Harvey, Adrien
Gaspe	2	Rimouski (2e Rang)	St-Pierre, Lucien
Peninsula	3	Matane (St-René Goupil)	Marquis, Alphée
and	9	Témiscouata (N.D. du Lac)	Ouellet, Eugène
Lower	10	Témiscouata(St-Juste du Lac)	Ouellet, J.C.
St.Lawrence	14	Bonaventure(St-Siméon)	Arsenault, Alphée
	15	Bonaventure(St-Siméon)	Poirier, Lorenzo
	46	Kamouraska(Ste-A.de la Poc.)	Hudon, L.P.
Eastern	4	Compton (Cookshire)	Kirby, Ian
Townships	5	Compton (Cookshire)	Hodge, Reggie
	6	Joliette(Ste-Mélanie)	Hétu, Oscar
Montreal	7	Joliette(Ste-Mélanie)	Tellier, Bernard
region	8	Joliette(Ste-Mélanie)	Riberdy, Arthur
and	11	St-Maurice(Yamachiche)	Rivard, R.
North Shore	12	Joliette(St-Félix de V.)	Rousseau, Philippe
to	16	D.-Montagnes(St-Hermas)	Touchette, Félix
Quebec	17	Argenteuil (Lachute)	Rogers, W.E.
	13	Roberval,(Pointe-Bleue)	RR.PP. Oblats
	18	Gatineau (Ste-Cécile de M.)	Renaud, A.
Gatineau	19	Gatineau (Ste-Cécile de M.)	Martineau, J.B.
District	20	Gatineau (Rupert)	Nesbitt, W.B.

TABLE 1. (continued)

TABLE 1. CLASSIFICATION OF THE QUEBEC STRAINS ACCORDING TO PLACE OF PRODUCTION.

REGION	STRAIN No.	LOCALITY	NAME OF GROWER
Gatineau	21	Gatineau(Ste-Cécile de M.)	Dion, Gaudiose
District	22	Gatineau(Luskville)	Allen, Edmond
	23	Gatineau(Rupert)	Robert, Emile

TABLE 2. QUEBEC STRAINS CLASSIFIED ACCORDING TO YEARS PRODUCED ON THE SAME FARM.

YEARS	STRAIN No.	LOCALITY
Over 25 years	46	Kamouraska(Ste-Anne de la Poc.)
Between 20 and 25 years	5	Compton(Cookshire)
	6	Joliette(Ste-Mélanie)
	7	Joliette(Ste-Mélanie
	8	Joliette(Ste-Mélanie)
	17	Argenteuil(Lachute)
	18	Gatineau(Ste-Cécile de M.)
	19	Gatineau(Ste-Cécile de M.)
	21	Gatineau(Ste-Cécile de M.)
	22	Gatineau(Luskville)
Between 10 and 20 years	4	Compton(Cookshire)
	12	Joliette(St-Félix de Valois)
	16	D.-Montagnes(St-Hermas)
	20	Gatineau(Rupert)
	23	Gatineau(Rupert)
Between 5 and 10 years	2	Rimouski (2e Rang)
	3	Matane(St-René Goupil)
	11	St-Maurice(Yamachiche)
	13	Roberval(Pointe-Bleue)
History not clear	1	Charlevoix(St-Urbain)
	9	Témiscouata (N.D. du Lac)
	10	Témiscouata(St-Juste du L.)
	14	Bonaventure(St-Siméon)
	15	Bonaventure(St-Siméon)

1.- Quebec Strains.

All the Quebec samples were produced in 1953, except 2(Rimouski) and 13(Roberval). The germination of these two was only 15.6 per cent and 5.6 per cent respectively, against over 80 per cent for all the other Quebec Strains. They were discarded, leaving 22 for transplanting in the field.

In Table 1 and 2, more details are given about the Quebec Strains.

2.- Canadian Strains.

The Central Experimental Farm, Ottawa, provided 11 samples, including one sample of the variety Ottawa and 10 samples of the new variety Lasalle which were produced in Ontario, Alberta and British Columbia. Five out of the ten samples of Lasalle had been collected the year-of-seeding at Hayes, Alberta.

A sample of Dollard was received from Macdonald College where it was developed.

Lasalle, the new Canadian variety of red clover, was licensed in 1952, and was brought under the auspices of the Canadian Forage Seed Project for multiplication. Foundation seed of Lasalle is obtained by blending together equal quantities of foundation seed of Ottawa and Dollard, in the expectation that it would have some of the desirable properties of these two excellent varieties.

Ottawa and Dollard are well known varieties of similar behaviour. In appearance they differ chiefly through the presence, very marked in Ottawa, of white or light-green V-shaped bands on the upper surface of the leaflets. Dollard has no such leaf markings. These two varieties

were used as checks.

In Table 3, more details are given about the Canadian Strains.

TABLE 3. CLASSIFICATION OF CANADIAN STRAINS WITH INDICATION OF STOCK AND PLACE OF PRODUCTION.

STOCK	STRAIN No.	PLACE OF PRODUCTION	NAME OF GROWER
Foundation (Ottawa)	44	Ontario	Forage Division, Central Exp. Farm
Foundation (Dollard)	45	Quebec	Macdonald College
Lasalle (registered, West)	24	Alberta(Flatbush)	Hugues, J.M.
	25	Alberta (Brooks)	Barg, J.
	26	B.C. (Gr.Forks)	Hove, B.I.
	27	Manitoba (Stead)	Thompson, P.J.
Lasalle(registered,East)	28	Ontario(Manotick)	Bracken, J.
Lasalle(year-of-seeding)	29	Alberta,(Hayes)	Wickenheiser, T.I.
	30	Alberta (Hayes)	Lickes, G.
	31	Alberta (Hayes)	Stober, J.
	32	Alberta (Hayes)	Engel, J.S.
	33	Alberta (Hayes)	Gaetz, P.

The different strains of Lasalle constituted the first generation to become available for testing. So, in the trial, 5 lots produced on the second year meadows were included with 5 lots produced on the year-of-seeding meadows.

Germination tests on Lasalle done in three replicates, indicated around 80 per cent for seed produced the second year, but less than 60 per cent for seed produced the year of seeding.

3.- United States Strains.

Thanks to Dr E.A. Hollowell, Principal Agronomist, Section of Forage Crops and Diseases, of the United States Department of Agriculture and C.S. Garrison, Executive Secretary of the Planing Committee of the National Foundation Seed Project, 10 samples of Kenland red clover have been provided for the investigation. They represented different stocks of seed. Kenland was developed at Kentucky Agricultural Experimental Station, beginning in 1936, and was registered in 1951. This variety has good growth characteristics and it is a doublecut or medium type, highly resistant to southern anthracnose.

In germination test, all the samples had a high percentage of germination which was over 80 per cent.

TABLE 4. KENLAND STRAINS WITH INDICATION OF STOCK AND PLACE OF PRODUCTION

STOCK	STRAIN No.	PLACE OF PRODUCTION
Breeder	34	Kentuckey
Foundation (1st generation)	35	Idaho
	36	California
	37	Washington
Registered (2nd generation)	38	Idaho
	39	California
	40	Washington
Certified (3rd generation)	41	Idaho
	42	Washington
Certified (4th generation)	43	Idaho

METHODS

All the samples had been gathered during the winter 1954. At the beginning of May, the experiment was started in the greenhouse, and in the middle of June, the seedlings were transplanted in the field.

a) Greenhouse

More than 10,000 2-inch clay and paper pots were filled with a soil mixture consisting of three parts of sterilized soil mixed with one part of sand. In accordance with the requirements of the trial, the space available in the field, and the large number of samples, it was decided to seed 186 pots of each of the 24 Quebec Strains; 238 of each Lasalle and Kenland sample and 400 each of Dollard and Ottawa.

So, there were in the greenhouse:

1.- Quebec Strains: 186 plants x 24 strains-		4,464 pots
2.- Lasalle and Kenland: 238 plants x 20 strains-		4,760 "
3.- Ottawa and Dollard: 400 " " x 2 " "		800 "
	Total	10,024 "

Every pot was seeded at the rate of 5 to 10 seeds per pot, and the seeds lightly covered by sand. To inoculate the soil mixture, water was applied, in which some clover-growing soil had been mixed.

At the seedling stage (trifoliate stage) two plants were left per pot, and one week later thinned to one plant per pot.

As mentioned before, two Quebec Strains were discarded at this stage on account of their too low percentage of germination:2(Rimouski) and 13(Roberval).

b) In the field

On June 19 and 20, the seedlings were transplanted in the East Field of the Agronomy Department of Macdonald College, Quebec. The field devoted to this investigation was divided in two ranges and was marked both ways 30 inches apart. It was then possible to put 26 plants per row. Of the Quebec Strains, seven rows were planted of each lot; nine rows were planted of each of Lasalle and Kenland; Dollard and Ottawa, used as checks, had 15 rows of each.

Thus, 9,464 single plants were under observation throughout the growing season 1954. Being 30 inches apart each way, the plants were allowed ample room for individual development, and the taking of notes was facilitated. Weeding was rather easy, even taking into account the frequent rainfalls.

At the end of July, a 0-16-8 fertilizer was side-dressed at the rate of 300 pounds to the acre.

In the second week of August, a classification was undertaken according to the types identified by Bird (1948) and described by Steppler and Raymond (1954). Every plant was carefully classified by the same person and the presence or absence of leaf markings was recorded.

At the end of August, three rows were cut in each plot and the fresh weight recorded in kilograms. Early in October, 50 mature heads were picked up at random among the rows left uncut. After being dried under room temperature, they were hand-threshed and cleaned. The weight of seed was recorded in grams, and also the 1,000-seed weight

was determined.

Early in November, the remaining half plot left uncut was cut down and all the material was removed.

METEOROLOGICAL CONDITIONS

To give a good picture of the meteorological conditions under which this investigation has been conducted, some date were collected from Reports published by the Department of Transport, Canada, and from weather records of Horticulture Department of Macdonald College.

The figures presented in Table 5 indicate the general trend of the weather during the summer 1954, in the Nacdonald College district.

TABLE 5. TEMPERATURE, PRECIPITATION AND HOURS OF SUNSHINE.

MONTH	TEMPERATURE F°	PRECIPITATION inches	HOURS OF SUNSHINE Hours	per cent
May	52.6	5.25	187	44
June	64.1	4.03	172	40
July	65.8	1.89	no data	no data
August	65.0	3.93	246	63
September	56.3	5.76	127	37

To show the differences between the normal and the 1954 summer temperature, the data recorded at Dorval will be taken as basis because there is a close agreement with the one taken at Macdonald College.

TABLE 6. COMPARISON BETWEEN TEMPERATURE DATA RECORDED AT MACDONALD COLLEGE AND DORVAL 1954.

MONTH	MACDONALD COLLEGE Mean 1954	DORVAL Mean 1954	DORVAL Mean for 12 yrs
May	52.6	53.7	55.4
June	64.1	64.7	65.4
July	65.8	67.5	70.6
August	65.0	65.3	68.4
September	56.3	56.9	59.7

From the data cited above, it appeared that the 1954 summer was really cooler with regard to the normal temperature (mean for 12 years). This specific point is well illustrated in Table 6.

The main point to emphazise on the weather conditions is the precipitation. In Table 7, comparison will be made in order to show how wet the summer 1954 was compared to normal weather.

TABLE 7. PRECIPITATION AT MACDONALD COLLEGE AND DORVAL COMPARED TO THE AVERAGE FOR 12 YEARS.

MONTH	MACDONALD COLLEGE inches	DORVAL	AVERAGE FOR 12 YRS(Dorval) inches
May	5.25	3.94	3.07
June	4.03	3.97	3.48
July	1.89	1.93	3.59
August	3.93	3.96	2.90
September	5.76	4.86	3.29

As indicated by Tables 5,6 and 7, the summer 1954 was wet, except for July, not very warm and rather cloudy. The repercussion in the field was a very marked vegetative growth of the plants. This agrees with the observation made by two Sweden workers, Julen and Nilsson-Leissner (1945) who reported that under damp and cloudy conditions a vigorous green mass is developed and the course of flowering of red clover proceeds more slowly.

EXPERIMENTAL RESULTS AND DISCUSSION

Section I Growth Types

Early in August 1954, the red clover population was examined carefully and classified according to Bird's growth types. Every plant was classified and recorded as such, by the same person.

In appendix Tables I, III and IV, details are given for each strain; but in the text tables, the averages only in percent are given.

The experimental results will be presented in the same order as given earlier.

1. Quebec Strains.

TABLE 8. CLASSIFICATION OF QUEBEC STRAINS BY GROWTH TYPES, GROUPED ACCORDING TO THE REGION OF THE PROVINCE

REGION	No. of PLANTS CLASSIFIED	PER CENT OF GROWTH TYPES				
		0	I	II	III	IV
Gaspe Peninsula	656	57	21	14	8	0
Lower St.Lawrence	535	5	8	19	54	14
Eastern Townships	363	1	0	15	80	4
Montreal Region and North Shore to Quebec City	1211	0	4	19	67	10
Gatineau	955	0	3	23	68	6

Table 8 summarizes a large number of figures and gives a brief picture of the behaviour of the Quebec Strains.

On diagram 2, the data reported in appendix-tables I have been plotted in a graph in order to show the wide range of differences in

DIAGRAM. 2 - QUEBEC STRAINS - GASPE PENINSULA AND LOWER ST.LAWRENCE STRAINS COMPARED TO DOLLARD, MACDONALD COLLEGE 1954.

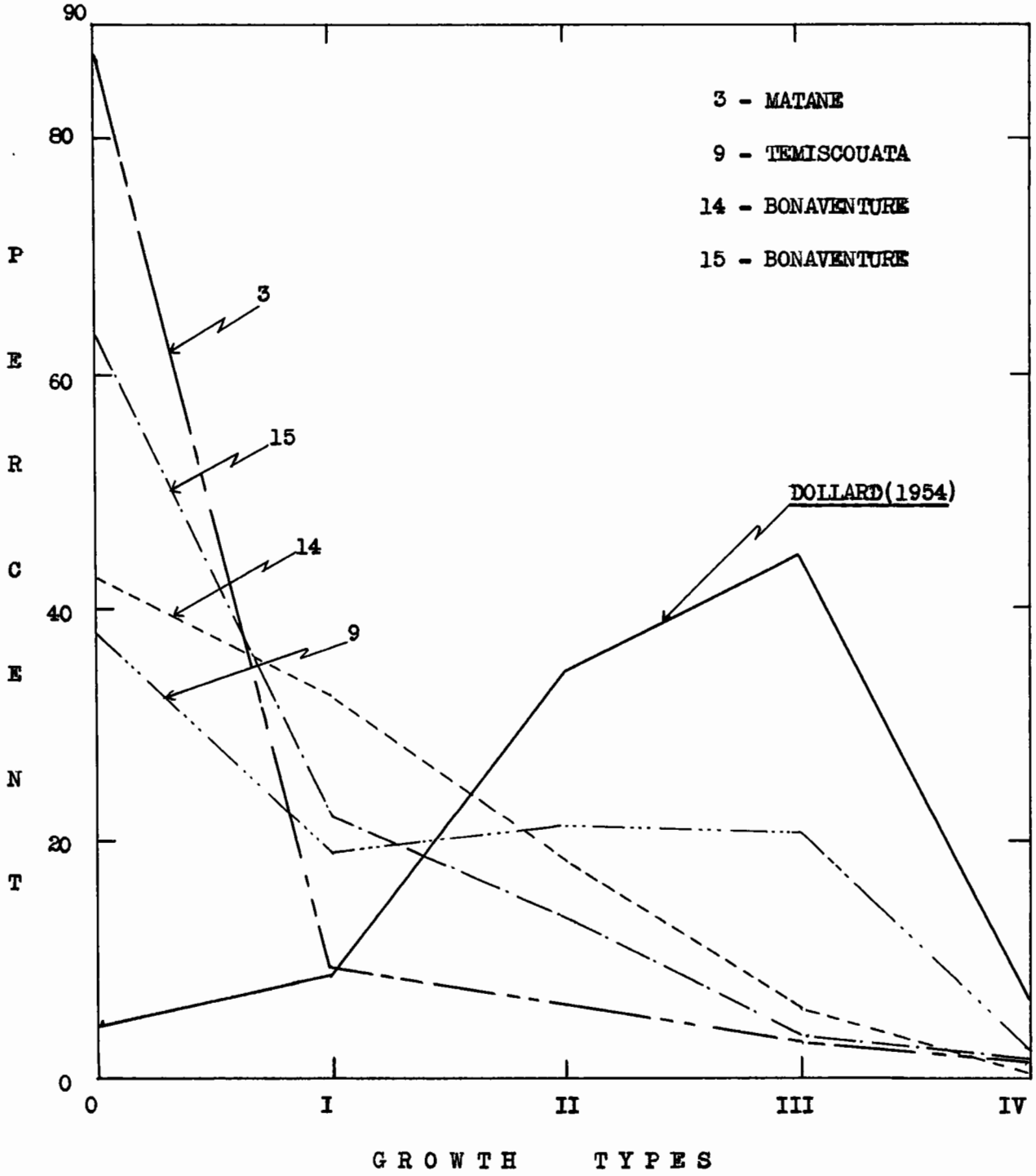
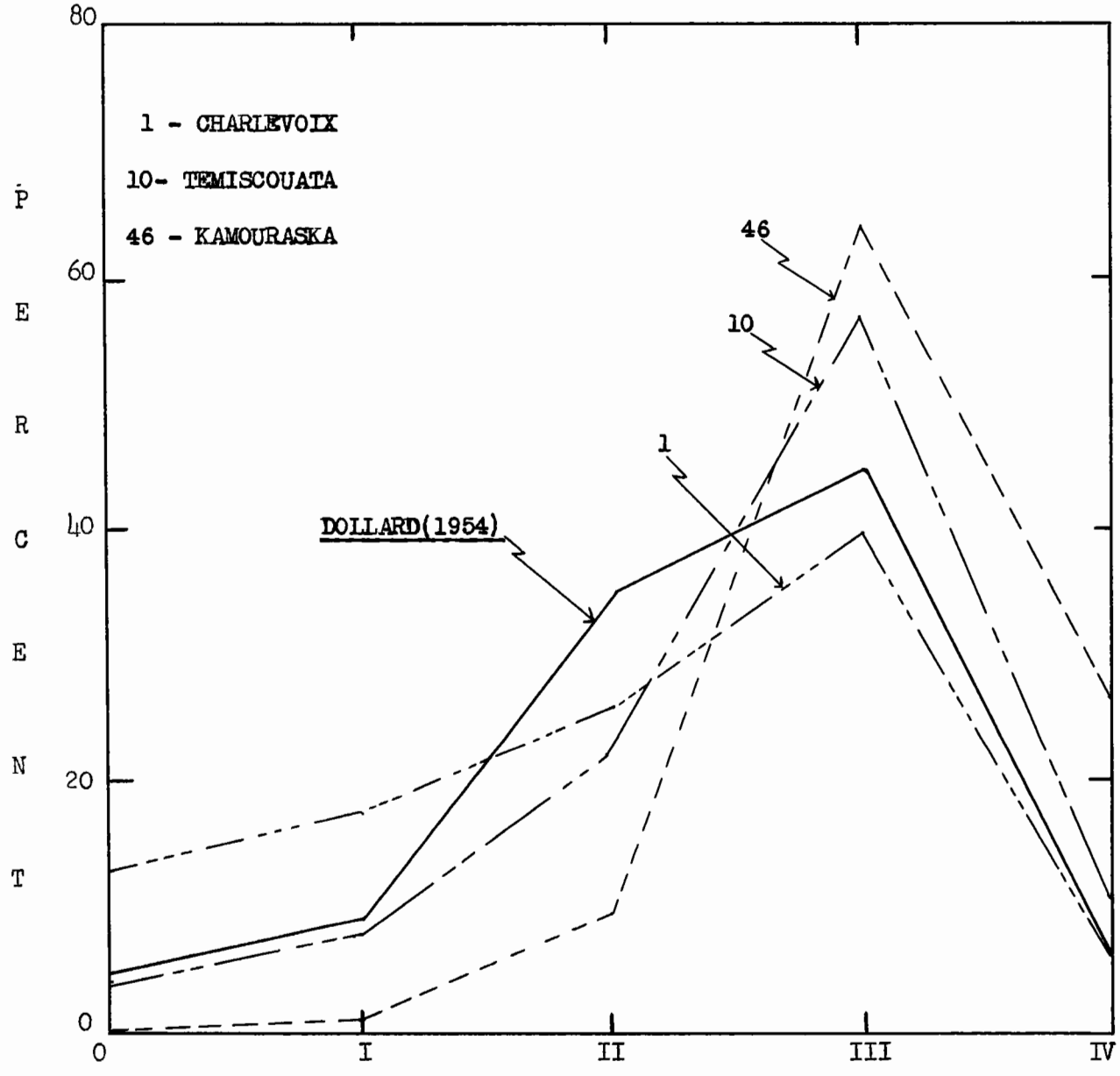


DIAGRAM. 3 - QUEBEC STRAINS - LOWER ST.LAWRENCE STRAINS COMPARED TO DOLLARD, MACDONALD COLLEGE 1954.



growth types observed in four Quebec strains of red clover grown in the Gaspe region and Lower St.Lawrence. The strain 3 from Matane is undoubtedly the latest one; Types 0 and I constitute more than 95 per cent of the types. There was a sharp line of demarcation between this strain and all the order strains. Just a few plants bore flowers, and all the remaining plants were a vigorous green mass of leaves.

In the same diagram, the deviation from Dollard is very well illustrated. Without any doubt, these four strains behaved as late types of red clover similar to those often described by research workers.

Studying diagram 3, it is interesting to notice that strains cultivated in the same area, therefore under the same or about the same climatic conditions, can behave in an other way. For example, 9(Temiscouata) and 10(Temiscouata) were grown in two different parishes; but in the same area. The strain 9(Temiscouata) was classified with the late types while 10(Temiscouata) is definitely an early with a peak on Types III. This difference could also be explained by the use of different varieties five or to ten years ago. In one case, 9(Temiscouata), the seed has been provided by Le Ministère de la Colonisation, in 1940. Mixture "B" was indicated as the source of 10(Temiscouata) and had been bought several years ago.

In the case of the strain 46 from Ste-Anne-de-la-Pocatière, the seed was planted ten days later than all the other strains; but transplanted at the same time.

According to Steppler and Raymond (1954) the expected

DIAGRAM. 4 - QUEBEC STRAINS - EASTERN TOWNSHIPS STRAINS COMPARED TO DOLLARD, MACDONALD COLLEGE 1954.

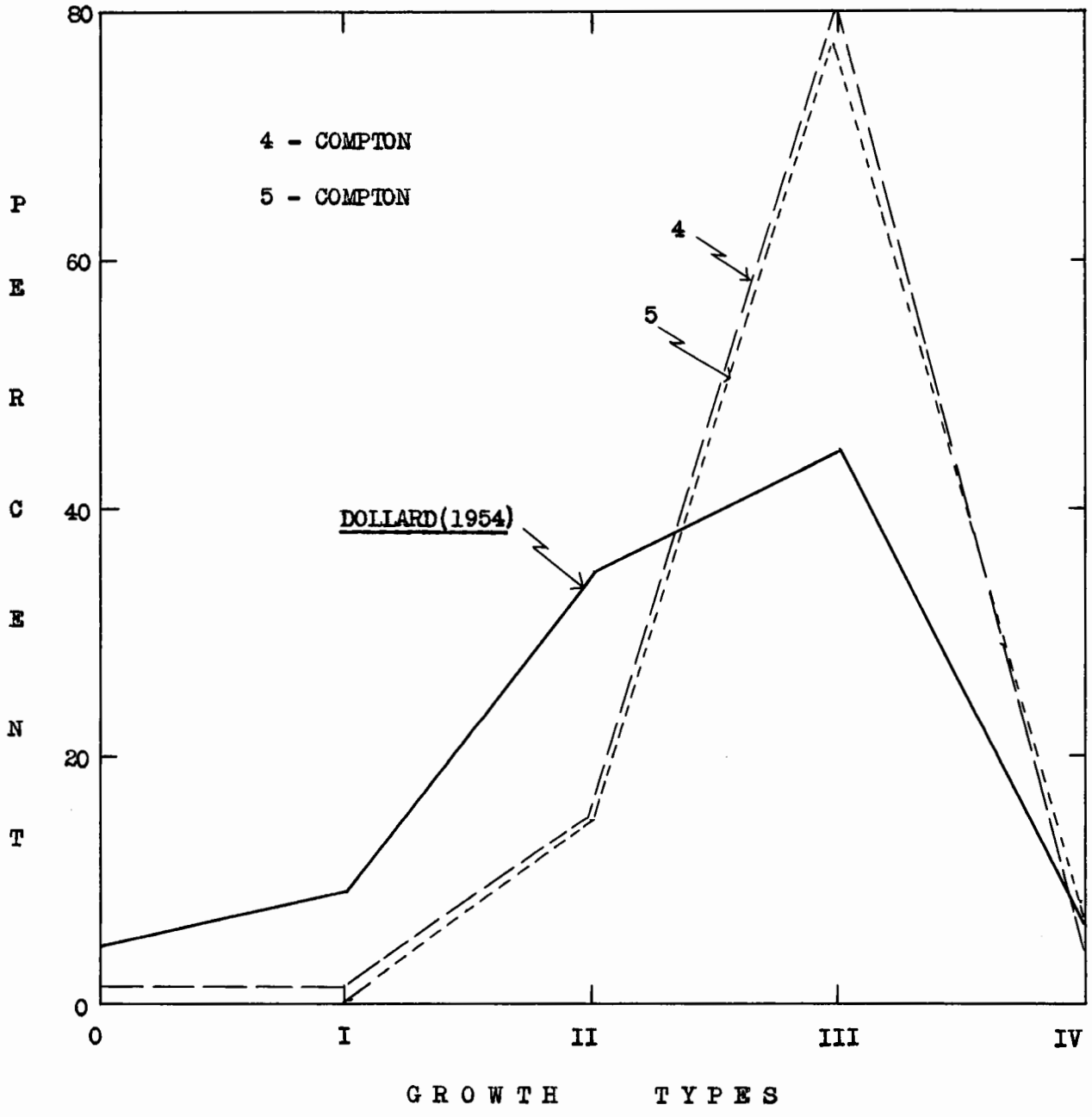


DIAGRAM. 5 - QUEBEC STRAINS - JOLIETTE STRAINS COMPARED TO DOLLARD, MACDONALD COLLEGE 1954.

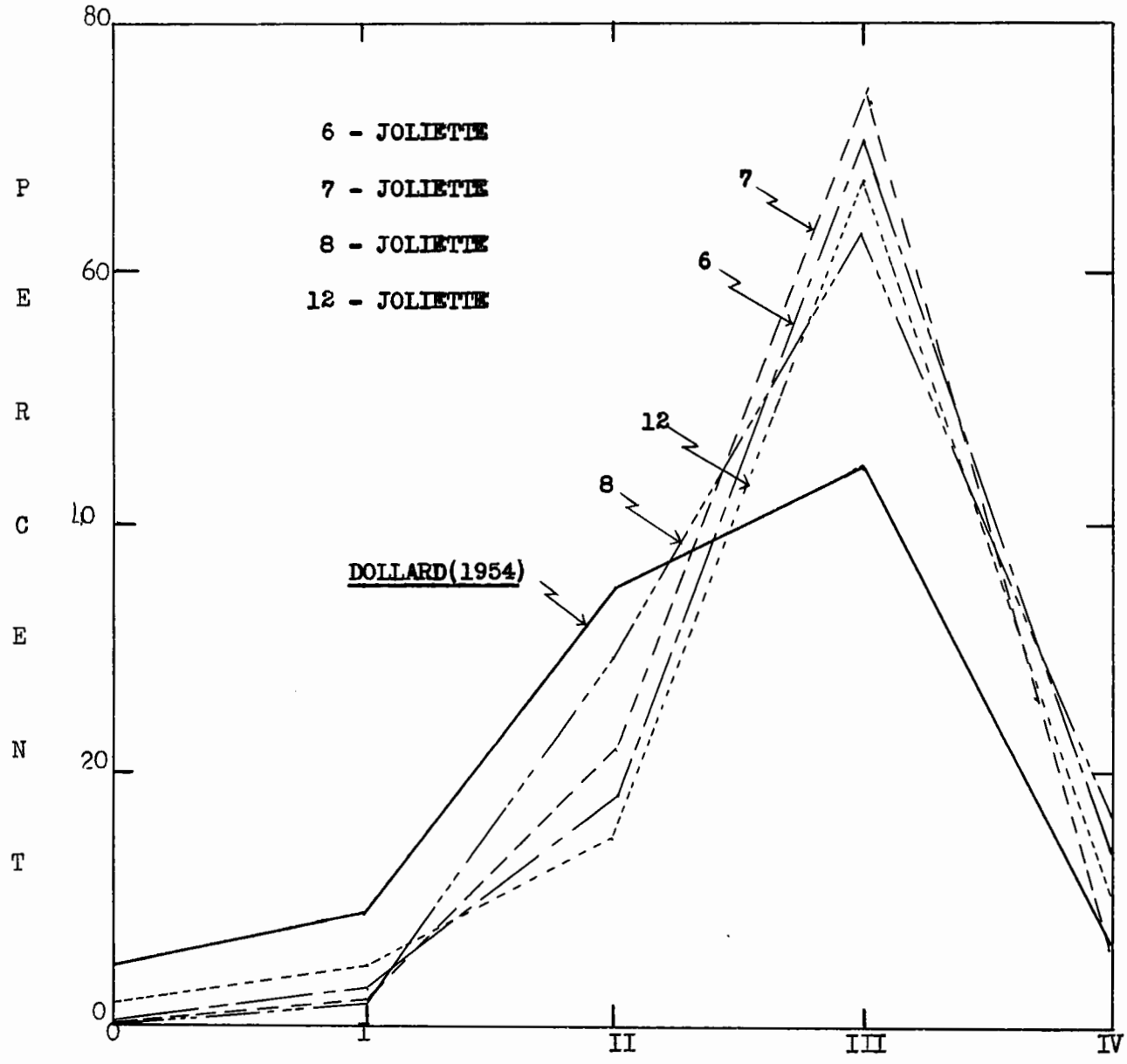


DIAGRAM. 6 - QUEBEC STRAINS - ST-MAURICE, DEUX-MONTAGNES AND ARGENTEUIL STRAINS COMPARED TO DOLLARD, MACDONALD COLLEGE 1954.

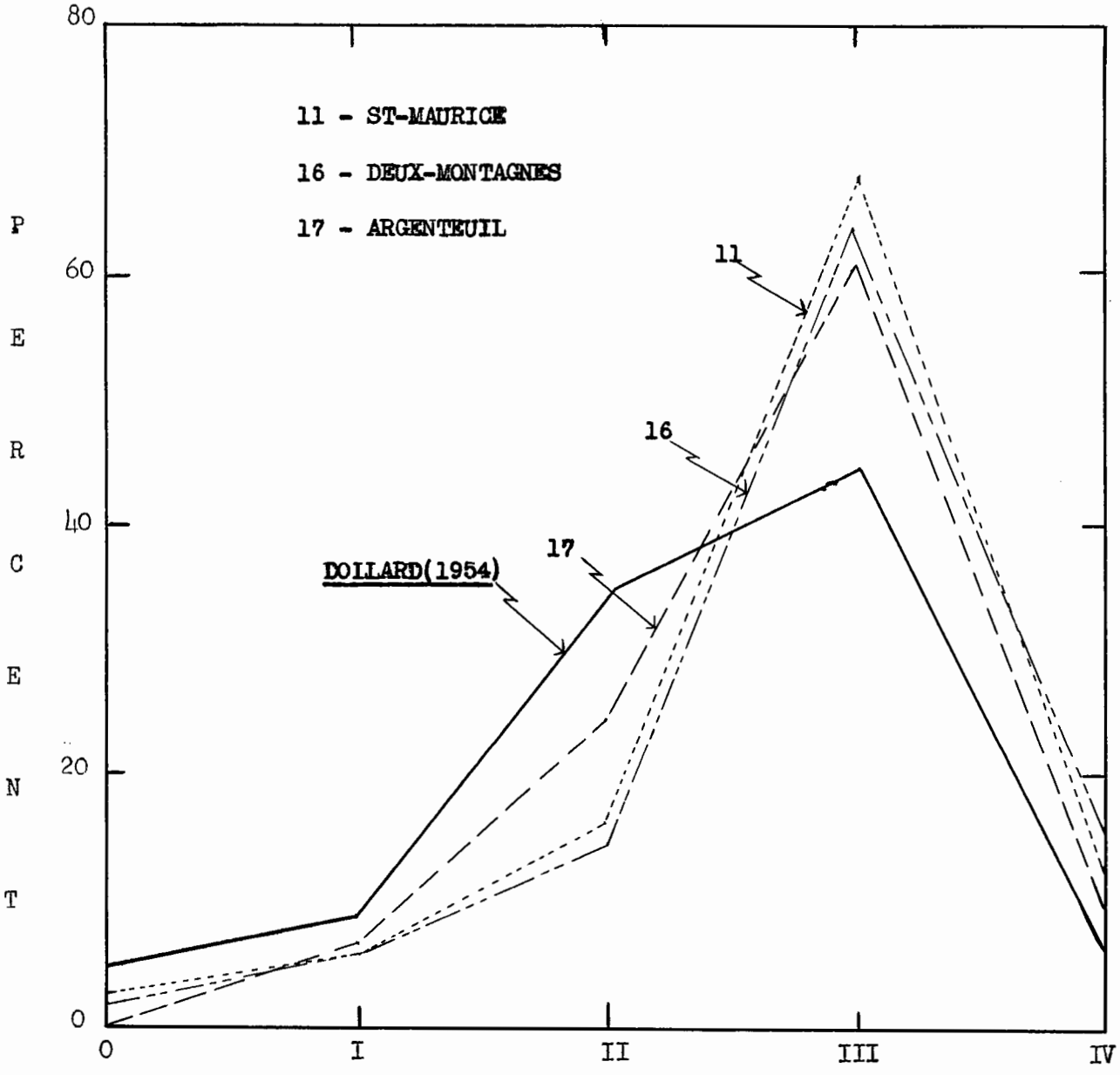
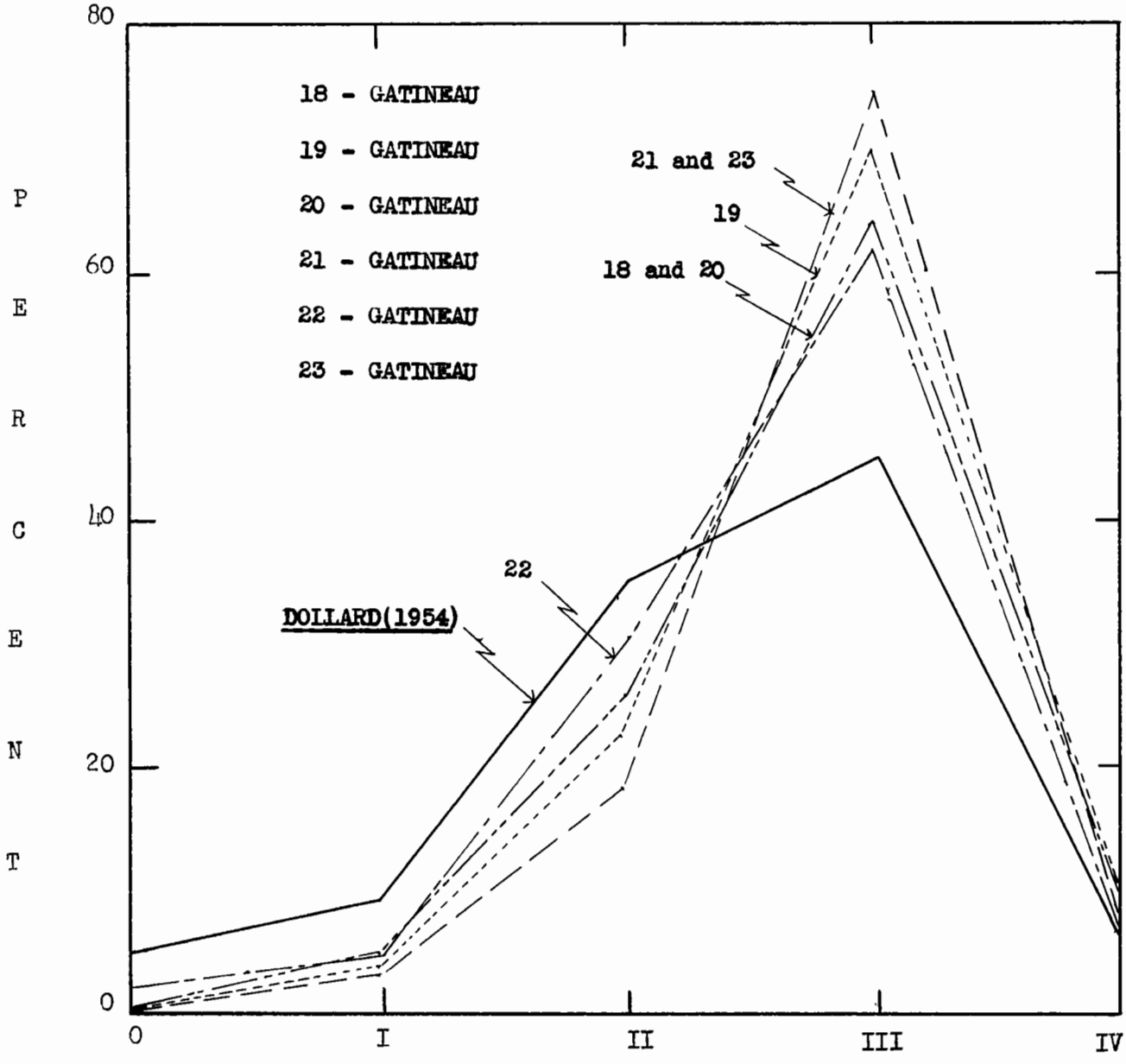


DIAGRAM. 7 - QUEBEC STRAINS - GATINEAU REGION STRAINS COMPARED TO DOLLARD, MACDONALD COLLEGE 1954.



distribution of types in Dollard could be grouped as follows: Types 0, I and IV composing about 25 per cent and the Types II and III, approximately 75 percent. In this respect the strains, 46(Kamouraska) and 10 (Temiscouata) are very close to Dollard; much closer than 1 (Charlevoix) which differs by Types 0 and I.

The Eastern Townships strains are closely related and are the earliest strains with a mean of 95 per cent of Types II and III. They were the first to flower. They did not form any rosettes and the plants were very stemmy. In Diagram 4, the deviation from Dollard is very marked.

The different strains from the Montreal region and North Shore to Quebec City are graphed in Diagrams 5 and 6 and summarized in Table 8. Considering Types II and III, the strains can be classified as very early, because the general mean for these two types is 96 per cent, that is 21 per cent over Dollard. The very close trend of the different curves must be emphasized too. It is very marked in Diagram 5 where the Joliette strains are studied. In Diagram 6, the remaining strains from three different localities are plotted and they are in close agreement. Again they are very different from Dollard.

The strains from Gatineau region, as shown in Diagram 7, do not differ within themselves, but must be classified also, as very early types. In this case, Types II and III were 91 per cent of the plants.

The Quebec strains could be grouped under two major types; late types or singlecut and early types or doublecut. Singlecut types are better adapted to northern clover growing areas where a short growing

DIAGRAM. 8 - CANADIAN STRAINS - LASALLE REGISTERED(WEST)
COMPARED TO DOLLARD, MACDONALD COLLEGE 1954.

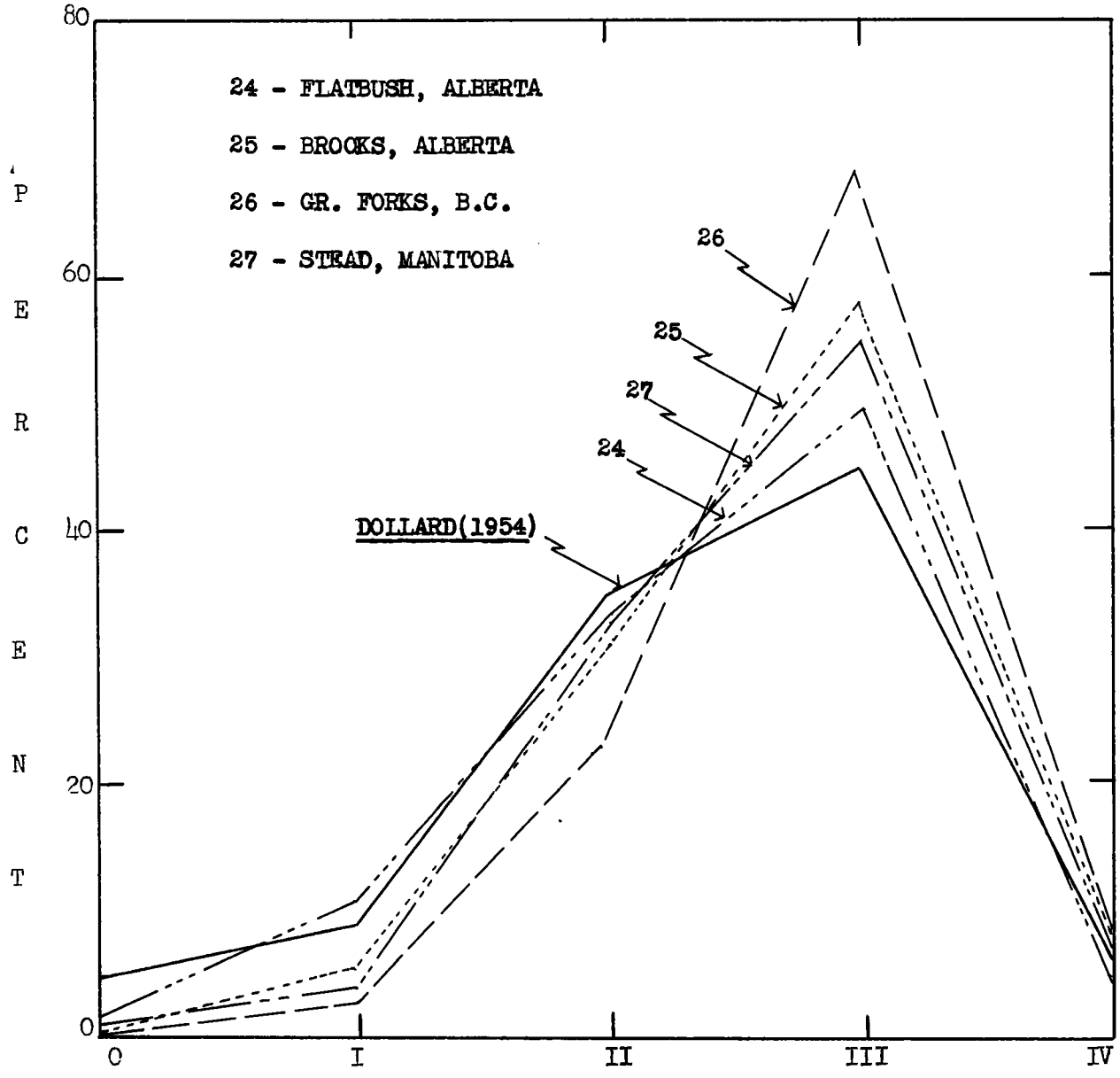
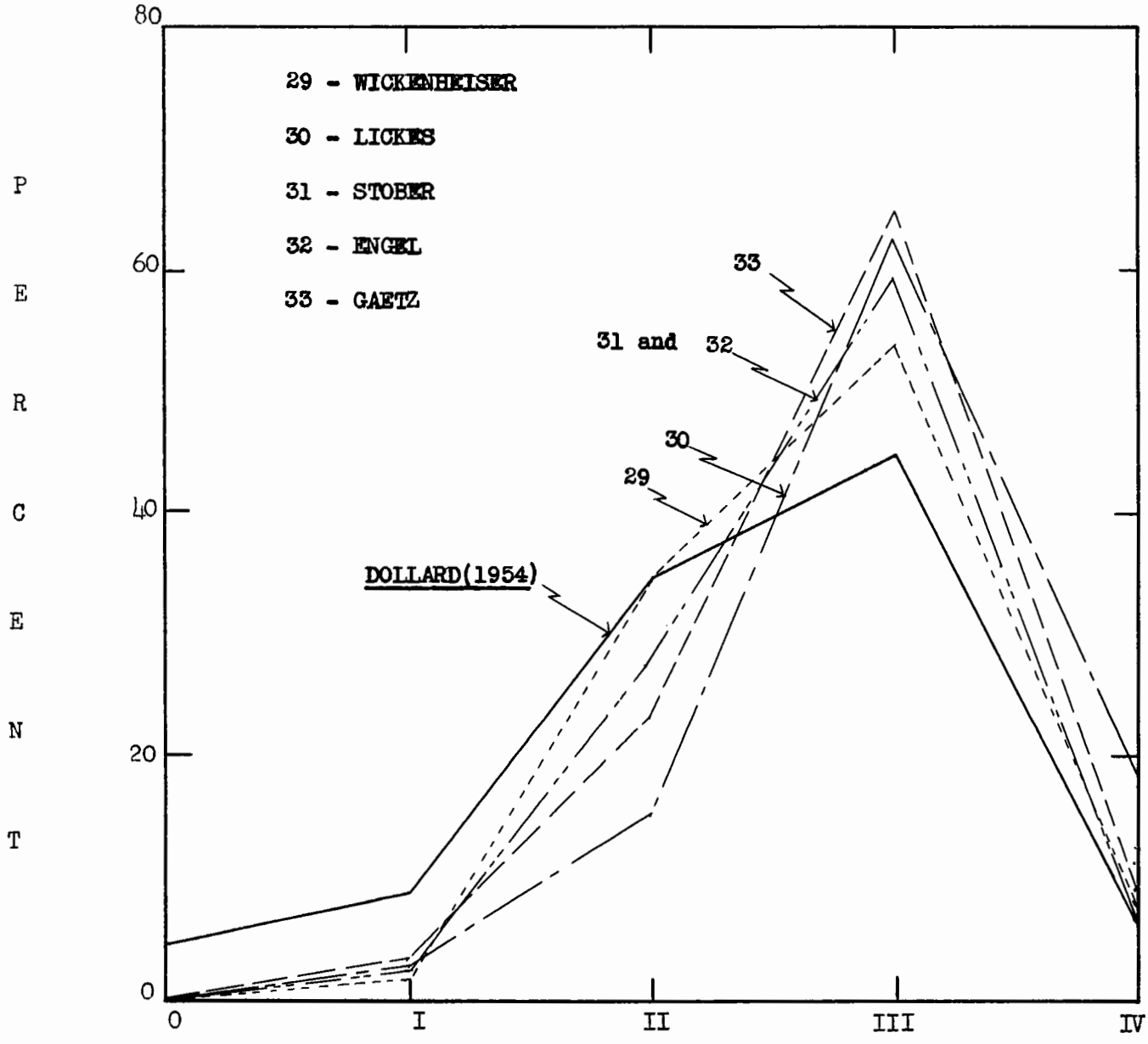


DIAGRAM. 9 - CANADIAN STRAINS - LASALLE(YEAR-OF-SEEDING) STRAINS COMPARED TO DOLLARD, MACDONALD COLLEGE 1954.



season makes it difficult to harvest more than one crop of hay per season. Thus, Gaspe Peninsula and the Lower St.Lawrence region in general will more successful with late types of red clover.

On the other hand, Gatineau, Eastern Townships, Montreal Region and North Shore to Quebec city are considered areas well adapted to grow doublecut red clover. The growing season is much longer and the temperature a little higher than in Eastern Quebec.

2.- Canadian Strains.

TABLE 9. CLASSIFICATION OF REGISTERED AND YEAR OF SEEDING LASALLE COMPARED TO OTTAWA AND DOLLARD, MACDONALD COLLEGE 1954.

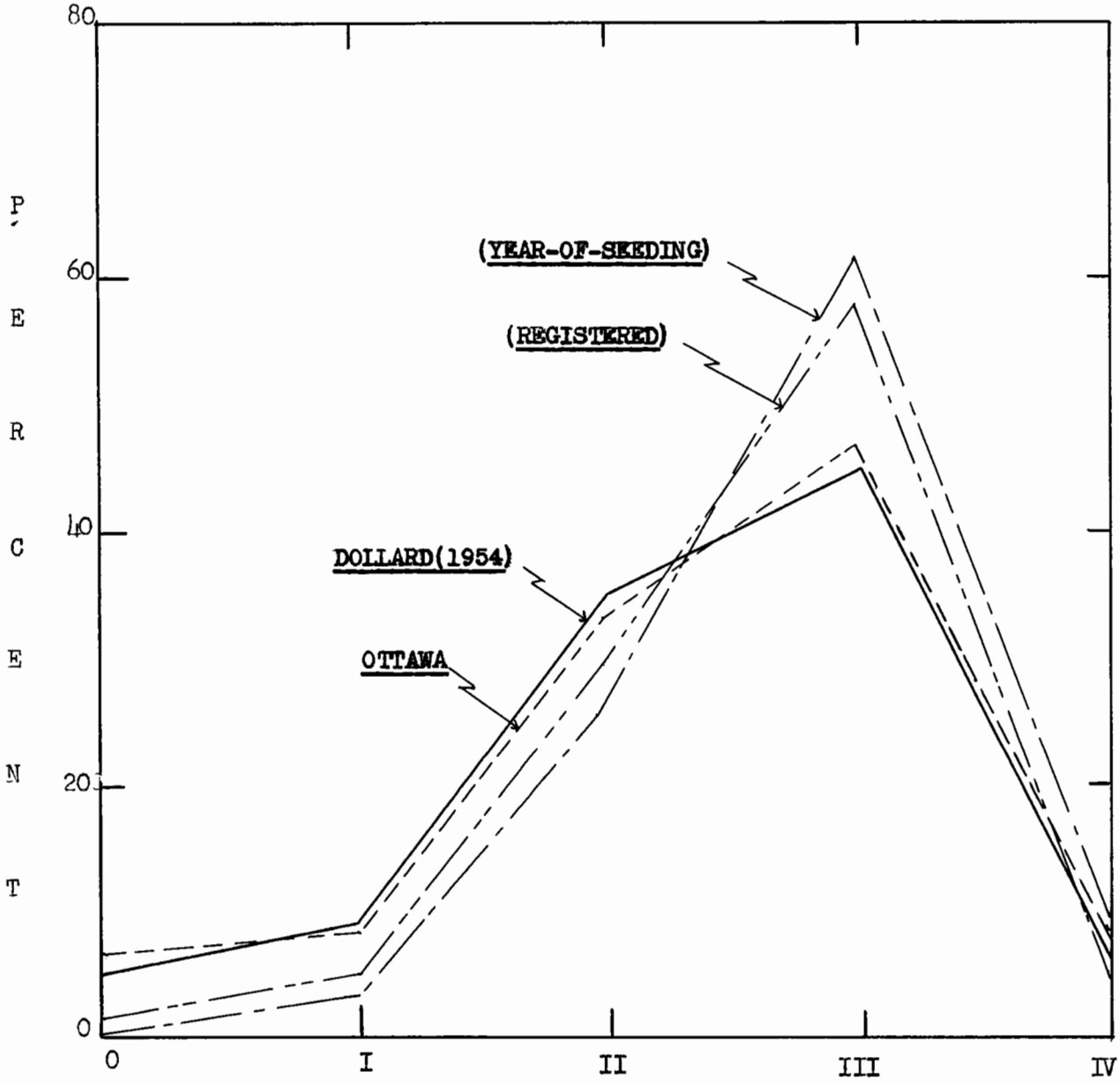
STOCK	LOCALITY	No. OF PLANTS CLASSIFIED	PER CENT OF GROWTH TYPES				
			0	I	II	III	IV
Foundation (Dollard)	Macdonald College	387	4.3	9.3	35.4	44.8	6.2
Foundation (Ottawa)	Ottawa	380	5.5	7.9	32.9	46.4	7.3
Registered (Lasalle)	West	932	0.7	5.3	30.4	58.1	5.5
Registered (Lasalle)	East	233	0.0	1.3	9.8	58.4	30.5
Year-of-seeding (Lasalle)	Alberta	1168	0.0	3.0	25.9	60.8	10.3

Table 9 shows the close agreement between Dollard and Ottawa, and the difference when the two groups of Lasalle are compared to the checks.

Diagram 8 gives the details of four strains of registered Lasalle produced in three different provinces. The general pattern of the curves is much the same, with a marked deviation of Type III ranging from 50 percent to 68 percent. The similarity between Dollard and strain 24 from Flatbush, Alberta must be underlined strongly.

In Diagram 9, five year-of-seeding lots grown by five different

DIAGRAM. 10 - CANADIAN STRAINS - LASALLE, MEAN OF REGISTERED AND YEAR-OF-SEEDING STRAINS COMPARED TO OTTAWA AND DOLLARD, MACDONALD COLLEGE 1954.



farmers within the same locality at Hayes, Alberta, show a remarkable similarity. According to the expectation, the seed harvested in the year of seeding was produced by plants of Types III and IV. Compared to Dollard which is expected to give 60 per cent of Types III and IV, the year-of-seeding strains gave 70 per cent as a mean. According to Steppler and Raymond (1954) the deviation from expected was not due to chance variation but seems reasonable to be attributed to the practice of taking seed in the year of seeding:"Certainly the conditions under which the seed was produced -- whether due to climate, management or a combination of them -- very definitely altered the stock from the expected percentages".

Comparing Dollard and Ottawa to Registered and Year-of-seeding Lasalle, Diagram 10 shows a deviation of Lasalle from the two checks but indicates the close relationships within strains of Lasalle.

3.- United States Strains.

TABLE 10 CLASSIFICATION OF FOUNDATION, REGISTERED AND CERTIFIED KENLAND COMPARED TO BREEDER STOCK, MACDONALD COLLEGE 1954.

STOCK	No. OF PLANTS CLASSIFIED	PER CENT OF GROWTH TYPES				
		0	I	II	III	IV
Breeder	234	0.0	1.3	23.5	65.4	9.8
Foundation	701	0.0	1.3	17.7	66.5	14.5
Registered	702	0.0	2.4	21.3	61.2	15.1
Certified(3 rd gen.)	459	0.0	8.9	32.7	53.1	5.2
Certified(4 th gen.)	228	0.0	6.6	39.0	47.4	7.0

The strains of Kenland were scored, late in August too, on the basis of growth types according to Bird's classification. All the

DIAGRAM. 11 - UNITED STATES STRAINS - KENLAND, FOUNDATION (1st GENERATION) PRODUCED IN THREE DIFFERENT STATES COMPARED TO BREEDER, MACDONALD COLLEGE 1954.

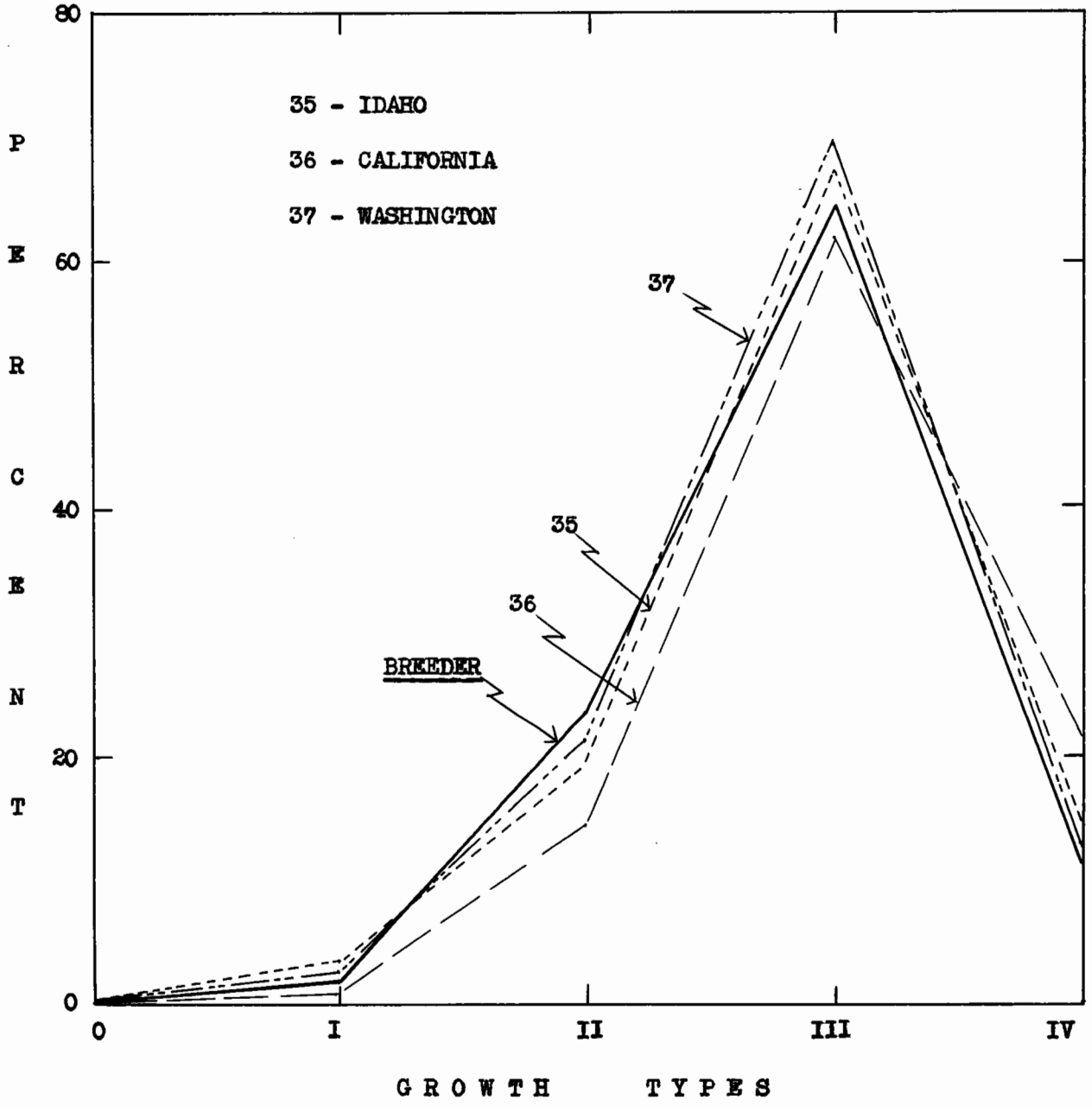
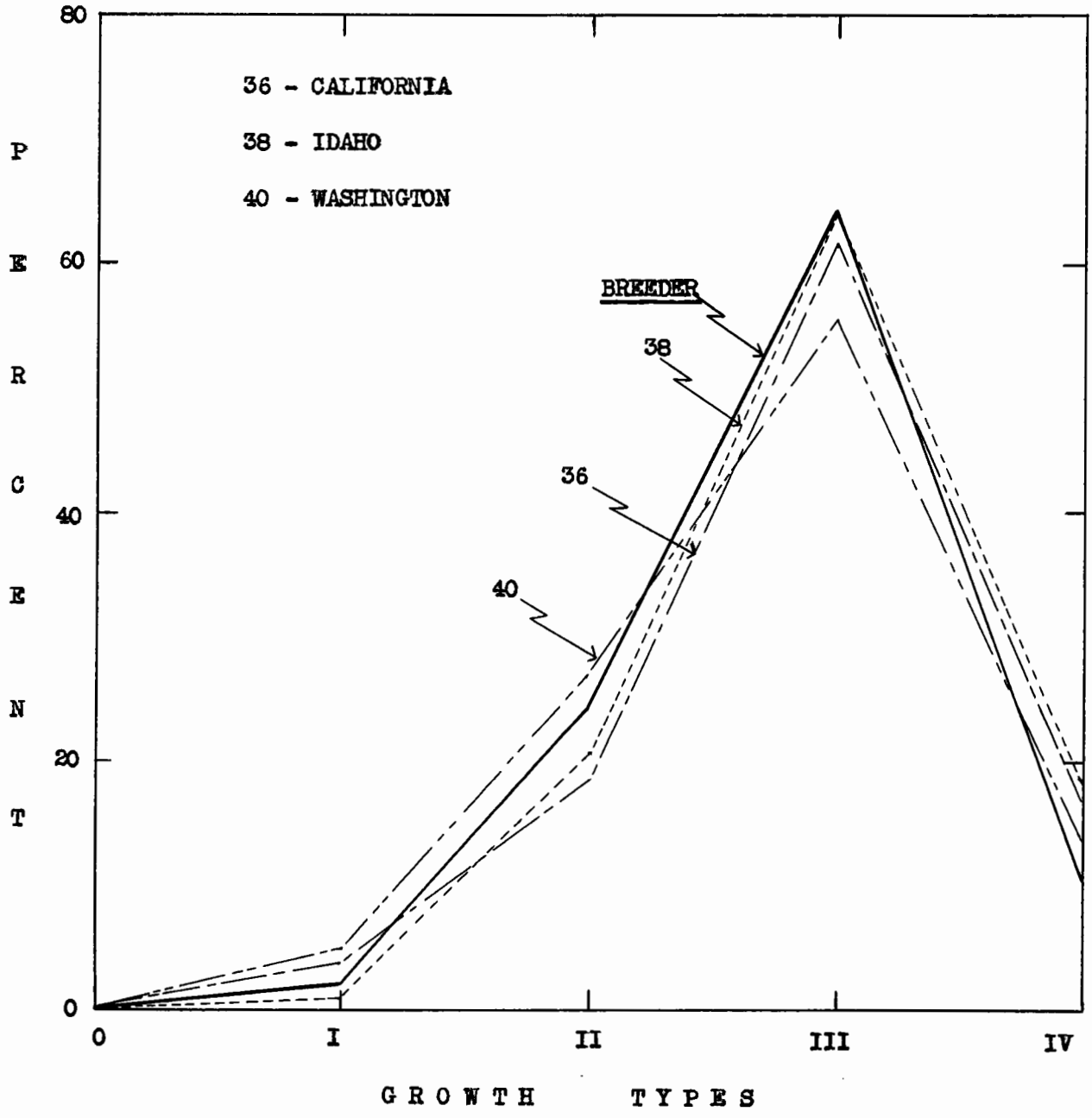


DIAGRAM. 12 - UNITED STATES STRAINS - KENLAND REGISTERED (2nd GENERATION) PRODUCED IN THREE DIFFERENT STATES COMPARED TO BREEDER, MACDONALD COLLEGE 1954.



plants have been scored by the same person.

Table 10 shows the deviation of the different groups from the breeder stock. The foundation stock is close to breeder stock but there is a little difference as far as Types II and IV are concerned. There is a decrease of Types II, with 17.7 per cent compared to 23.5, and an increase of Types IV with 14.5 per cent in regard of 9.8 for breeder stock.

Diagram 11 compares foundation stock produced in three different States, namely Idaho, California and Washington, to breeder stock grown in Kentucky. According to the data presented in Table 9, there is not much difference between the strains, and this is well indicated by Diagram 11.

Registered Lasalle is compared to Breeder in Diagram 12. Referring to Appendix Table IV, it appears that Types IV are higher than those of Breeder. However two strains 38 (Idaho) and 39 (California) follow about the same type of curve, while 40 (Washington) shows a decrease of Types III and an increase of Types II.

Diagram 13 compares certified Kenland to breeder. It is rather surprising to notice the marked deviation of the different certified strains from breeder. The data presented in Table 10 show the same situation, that is, a large deviation from the expected breeder. The strong differences appears on Types II and III. Let us examine 41 (Idaho) and 42 (Washington) both certified (3rd generation) in relation with breeder. Their average for Types II and III is 32.7 and

DIAGRAM. 13 - UNITED STATES STRAINS - KENLAND, CERTIFIED (3rd GENERATION) AND (4th GENERATION) PRODUCED IN TWO DIFFERENT STATES COMPARED TO BREEDER, MACDONALD COLLEGE 1954.

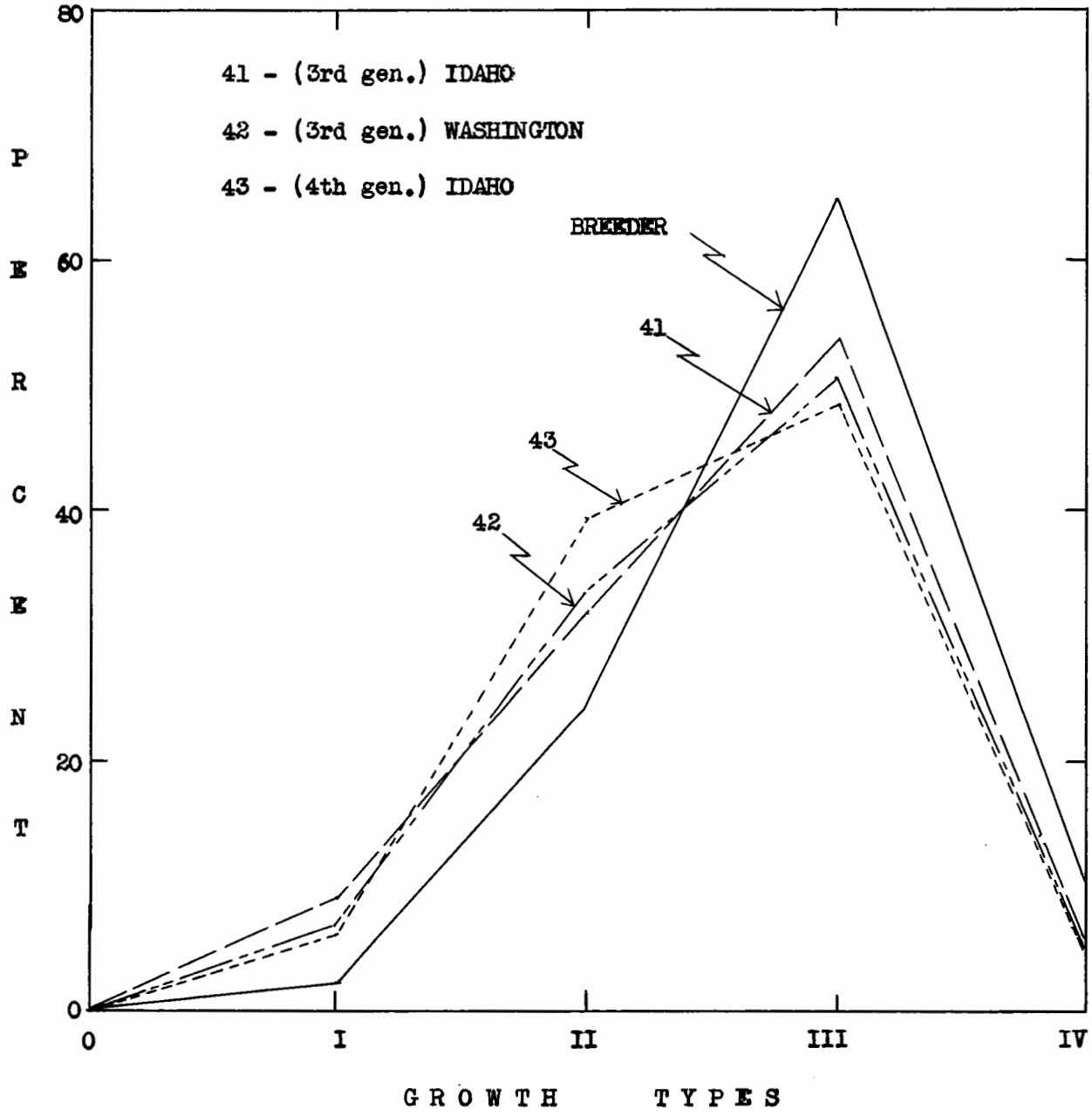
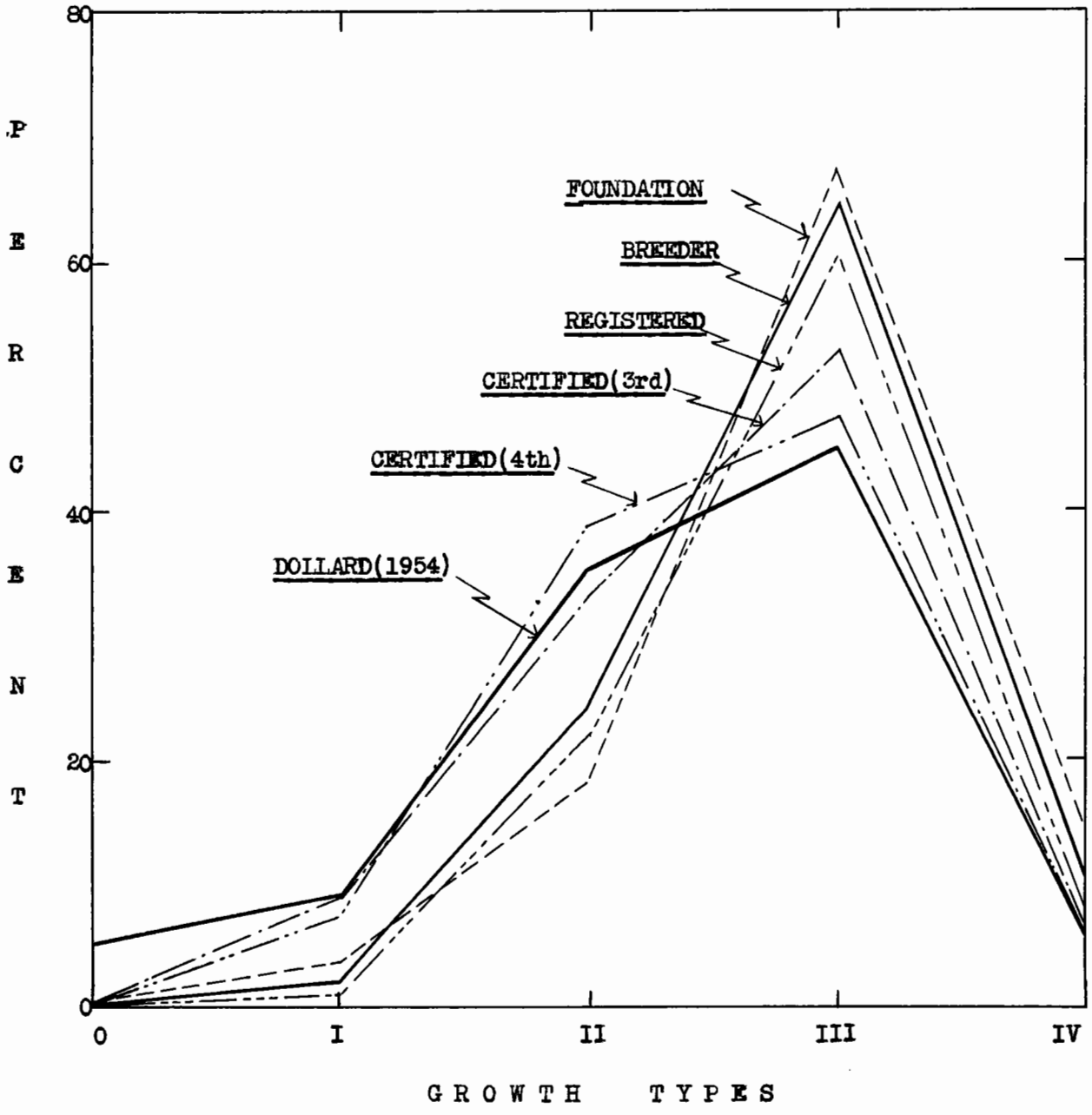


DIAGRAM. 14 - UNITED STATES STRAINS - KENLAND, BREEDER, FOUNDATION, REGISTERED, CERTIFIED (3rd and 4th GENERATION) COMPARED TO DOLLARD, MACDONALD COLLEGE 1954.



53.1 per cent compared to 23.5 and 65.4 per cent for breeder. Certified (4th generation), 43 (Idaho) behaves very differently from breeder. This strain is low in Types III but high in Types II, which is 47.4 per cent for Types III and 39.0 for Types II. The picture is somewhat different, when compared to Dollard.

TABLE 11 CERTIFIED (4th generation) KENLAND COMPARED TO DOLLARD ON THE BASIS OF GROWTH TYPES.

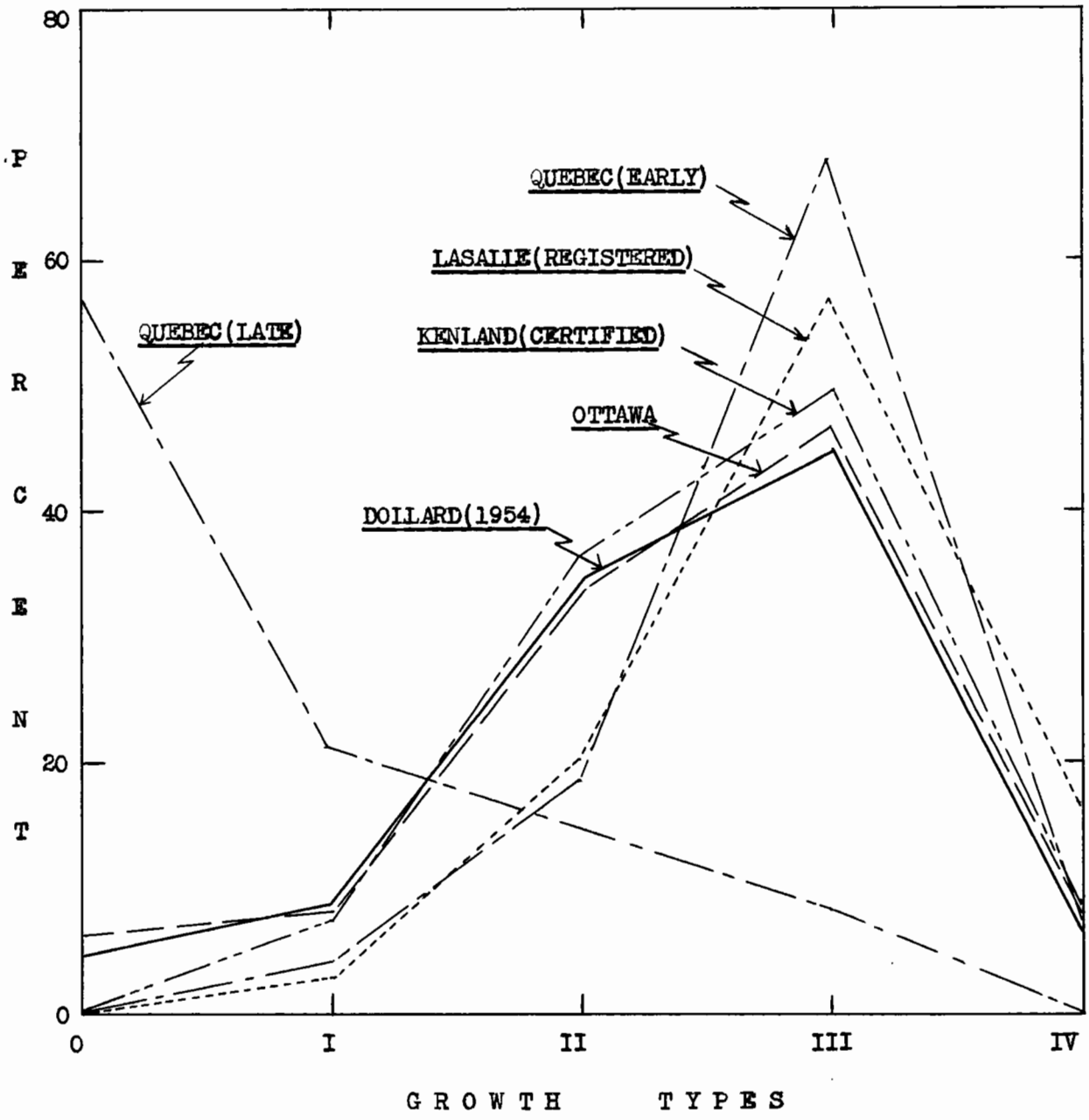
STOCK	No. OF PLANTS CLASSIFIED	PER CENT OF GROWTH TYPES				
		0	I	II	III	IV
Foundation (Dollard)	387	4.3	9.3	35.4	44.8	6.2
Certified (4th gen.)	228	0.0	6.6	39.0	47.4	7.0

Table 11 shows the similarity of Certified (4th generation) Kenland to Foundation Dollard.

To summarize the experimental data in relation with Kenland strains classified according to Bird's types, Table 10 can be reinforced by Diagram 14. Breeder, foundation and registered Kenland follow the same pattern, while certified (3rd generation) shows a little difference. Compared to Dollard, certified (4th generation) behaves much the same way. All the other groups are very different from Dollard, as indicated in Diagram 14.

Diagram 15 shows the general trend of the different varieties and strains tested at Macdonald College. The two checks, Ottawa and Dollard behaved the same way, and this can be seen in Appendix-Table VI. The two Quebec strains represent two major groups of red clover, namely, singlecut or late type and doublecut or early type. The two curves

DIAGRAM. 15 - SUMMARY - QUEBEC STRAINS (LATE AND EARLY), REGISTERED LASALLE, CERTIFIED KENLAND COMPARED TO OTTAWA AND DOLLARD, MACDONALD COLLEGE 1954.



(Quebec early and late) were plotted after the general mean of the various Quebec strains. Certified Kenland and registered Lasalle has been chosen to compare with checks because the seed is available to the farmers. Although they differ from Ottawa and Dollard, they are in agreement between themselves.

Section II - Green matter yield and growth types.

At the end of August, three rows of each strain were cut and the green weights recorded in kilograms. To simplify comparison, the actual weights have been corrected for 78 plants and are presented also as relative yields, foundation Dollard being taken as the basis of 100. The summarized results are given in Table 12 for the Quebec strains, Table 13 for the Canadian strains and Table 14 for the U.S. strains.

TABLE 12. ACTUAL AND RELATIVE YIELD OF GREEN MATTER ON A BASIS OF 78 PLANTS OF THE QUEBEC STRAINS.

STOCK	REGION	GREEN MATTER YIELD	
		actual	relative
		kg	%
Foundation (Dollard)	Macdonald College	17.06	100
Late	Gaspe Peninsula	10.43	61
Early	Lower St.Lawrence	15.33	90
Early	Eastern Townships	17.54	103
Early	Montreal Region and North Shore to Que. city	16.24	96
Early	Gatineau	16.05	94

It is noted in this year-of-seeding test that the late strains gave a much lower yield in green matter than the earlies. The average for the lates was 10.43 kilograms or 61% compared to 16.29 kilograms or 96% for the earlies, which compare favorably with Dollard.

Grouped by ages the various strains did not differ very much. For the strains grown between 20 and 25 years on the same farm, the general mean is 16.37 kilograms, a relative yield of 96%. The 10 to

20 year strains gave an average of 16.00 kilograms with a relative yield of 94%. They all are fairly close to Dollard. The details are given in Appendix Table VIII.

TABLE 13. ACTUAL AND RELATIVE YIELD OF GREEN MATTER ON A BASIS OF 78 PLANTS OF THE CANADIAN STRAINS.

STOCK	LOCALITY	GREEN MATTER YIELD	
		actual	relative
		kg	%
Foundation (Dollard)	Macdonald College	17.06	100
Foundation (Ottawa)	C.E. Farm, Ottawa	19.78	116
Lasalle (registered)	West	35.18	206
Lasalle (registered)	East	22.90	134
Lasalle (year-of-seeding)	Alberta (Hayes)	28.79	169

Lasalle registered (West) gave by far the highest yield of green matter, with an average the double of Dollard. Lasalle registered (East) yielded better than Dollard, but less than Lasalle (year-of-seeding). It can be noticed than the five year-of-seeding strains did not differ between themselves as shown in Appendix Table IX.

The Kenland strains, all gave a higher yield than Dollard; but it is surprising to notice the decreasing yield of strains as they progress from breeder stock down through the certified lots. Detailed results from the Kenland strains are given in Appendix Tables X and XI.

TABLE 14. ACTUAL AND RELATIVE YIELD OF GREEN MATTER ON A BASIS OF 78 PLANTS OF KENLAND RED CLOVER.

STOCK	GREEN MATTER YIELD	
	actual	relative
	kg	%
Foundation (Dollard)	17.06	100
Kenland (Breeder)	33.63	197
Kenland (Foundation, 1st generation)	28.61	168
Kenland (Registered, 2nd generation)	25.32	148
Kenland (Certified, 3rd generation)	23.72	139
Kenland (Certified, 4th generation)	23.48	138

Table 15, summarizing the results from all strains, strikingly indicates how poor forage yielder the local strains are compared with the known varieties.

TABLE 15. ACTUAL AND RELATIVE YIELD OF GREEN MATTER ON A BASIS OF 78 PLANTS OF QUEBEC, CANADIAN AND UNITED STATES STRAINS.

STOCK	LOCALITY	GREEN MATTER YIELD actual kg	relative %
Foundation (Dollard)	Macdonald College	17.06	100
Foundation (Ottawa)	C.E. Farm, Ottawa	19.78	116
Local (late)	Quebec	10.43	61
Local (early)	Quebec	16.28	95
Lasalle (registered)	Canada	32.72	192
Lasalle(year-of-seeding)	Canada	28.78	169
Kenland (Breeder)	U. States	33.63	197
Kenland (Foundation)	" " "	28.61	168
Kenland (registered)	" " "	25.32	148
Kenland (certified)	" " "	23.60	139

This year-of-seeding test indicates that old Quebec strains, generally considered as well adapted to the various regions where they have been produced, were the poorest forage yielders. Yields of registered Lasalle clover were slightly lower than those of Kenland but remain much higher than both checks, Dollard and Ottawa. Keeping in mind that the blend Lasalle was expected to be as good as both parents, Ottawa and Dollard, it is rather interesting to underline that high forage yield.

Kenland (breeder), as indicated in Table 15, was the highest forage yielder, almost the double of Dollard. Results of the tests of the successive generations of Kenland indicate that, under Macdonald conditions, the high yield advantage of Kenland decreased in inverse ratio to the number of generations.

A similar observation has been made by R.L. Davis and K.E. Beeson (1955) of Purdue University who compared 49 different lots of Kenland clover, in 1954, at Lafayette. Their foundation, registered and certified lots were from seed produced in Washington, Utah, Kentucky, Idaho, Montana, Wyoming, Oregon and California.

"With each advance in the generation there was a decrease on second-cutting hay yield in the Purdue plots. Foundation seed produced 90 per cent as much hay as breeder's seed, registered only 85 per cent and certified only 82 per cent".

They concluded that "by limiting the number of generations, in seed production, the yield advantage of Kenland could be maintained".

Section III - Seed Yield and Growth Types.

Early in October, among the remaining plants (which included four rows for the Quebec strains and six for Kenland and Lasalle) 50 mature heads were picked at random, and every strain was sampled the same way. After drying under room temperature, every sample was hand-threshed and the seed cleaned properly. The seed yield for the various strains was recorded in grams. Moreover the one thousand-kernel-weight (T-K-W) was determined. It was obvious that the late strains, namely 3(Matane), 9(Temiscouata), 14 and 15(Bonaventure) did not set any seed because only a few plants bore mature heads.

In Appendix Tables VII and VIII, details are given for the Quebec strains as far as seed yield and T.K.W. are concerned. Table 16 presents the summarized data for the Quebec strains. Since Dollard, was an unsatisfactory seed-yielder (in this test), Ottawa was selected as a standard of 100.

TABLE 16. ACTUAL AND RELATIVE SEED YIELD ON A BASIS OF 50 HEADS FOR QUEBEC STRAINS.

STOCK	REGION	SEED YIELD PER 50 HEADS		T.K.W.
		actual	relative	
		gm	%	grams
Foundation(Ottawa)	C.Exp.Farm, Ottawa	3.90	100	1.4002
Local	Lower St.Lawrence	7.06	181	1.5068
Local	Eastern Townships	6.47	166	1.4674
Local	Montreal Region and N.S. to Quebec city	7.23	185	1.5200
Local	Gatineau	7.05	181	1.5592

All the Quebec strains are by far much better seed yielder than Ottawa. Except the Eastern Townships group, the seed yield of the various strains of the other regions did not vary markedly. The one thousand-kernel-weight of the Quebec strains was higher than that of Ottawa and remained rather consistent between the various strains.

TABLE 17. ACTUAL AND RELATIVE SEED YIELD OF QUEBEC STRAINS CLASSED BY AGES.

STOCK	AGES	SEED YIELD PER 50 HEADS actual	relative	T.K.W.
		gm	%	gm
Foundation(Ottawa)		3.90	100	1.4002
Local	Between 20 and 25 yrs	6.75	178	1.5180
Local	Between 10 and 20 yrs	7.61	195	1.5284

Grouped by ages, as shown in Table 17, old Quebec strains differed from Ottawa. Not only the seed yield differed, but also the T.K.W. This can be explained by the earlier maturity of the Quebec strains. They were able to form and mature their seed earlier than Ottawa red clover.

TABLE 18. ACTUAL AND RELATIVE SEED YIELD OF LASALLE ON A BASIS OF 50 HEADS.

STOCK	SEED YIELD PER 50 HEADS actual	relative	T.K.W.
	gm	%	gm
Foundation (Ottawa)	3.90	100	1.4002
Lasalle (Registered, West)	7.87	202	1.5893
Lasalle (Registered, East)	8.95	229	1.5560
Lasalle (Year-of-seeding)	6.07	156	1.4508

The blend variety Lasalle gave a much higher seed yield than

Ottawa. Even the year-of-seeding lots were superior to Ottawa. These five strains, except 33 (Hayes) had a similar seed yield.

The detrimental effect of taking seed in the year of seeding, as expected by most of experimenters,did not appear to affect the seed yield of the next generation. However a decrease was noticed when Lasalle (year-of-seeding) was compared to Lasalle (registered). The thousand-kernel-weight of the year-of-seeding lots showed also a difference. The seed harvested the year of seeding appeared to be lighter than registered seed.

TABLE 19. ACTUAL AND RELATIVE SEED YIELD OF KENLAND ON A BASIS OF 50 HEADS.

STOCK	SEED YIELD PER 50 HEADS		T.K.W.
	actual	relative	
	gm	%	gm
Foundation (Ottawa)	3.90	100	1.4002
Kenland (Breeder)	5.12	131	1.3288
Kenland (Foundation)	4.39	112	1.4608
Kenland (Registered)	6.18	158	1.5163
Kenland (Certified)	3.93	101	1.3202

Kenland was a better seed yielder variety than Ottawa; but remained inferior to Lasalle and Quebec strains. The seed yield of foundation and certified lots of Kenland was slightly superior to Ottawa; but Kenland (registered) was much superior to Ottawa.

As a whole, the difference in seed yielding ability of the various seed lots may be attributed, partly, to the relative date of maturity. The early Quebec strains might be considered as the earliest that was included in our test, followed very closely by Lasalle strains.

Section IV - Leaf Markings.

Great variations occur in red clover as it is well known in respect to the leaves. Most red clover plants have the leaflets marked with a blotch which was described by Kajanus (1912) and cited by Malte (1920). "The flattish epidermis cells of the upper leaf surface multiply in certain areas at a faster rate than do the palisade cells underneath, the results being that the spaces filled with air are created between the latter cells. At the same time the lower walls of the lower epidermis cells bulge out, giving the cells in question the shape of plano-convex lenses. As a consequence the palisade cells located underneath are being exposed to more light which, in turn, brings about a partial destruction of their chlorophyll. The markings of red clover leaves are consequently caused by the presence of air-filled spaces between the palisade cells combined with a partial destruction of the chlorophyll in the said cells".

Williams (1927) reported that "there seems to be no distinctive difference between the various varieties in respect to the white markings on the leaves. This character is extraordinarily variable and shows a very wide range of variation in all varieties not only in the form and size, but also in shape, intensity of colour, and position on the leaves. In every variety there are a few plants in which the markings are completely absent".

Wexelsen (1938) noted that cultivated red clover had only 9.84 per cent plants without leaf spot, while wild clover had 31.72 per cent. He noticed too, that leaf spot varies in size form and intensity and to their location on the leaves.

Malte (1920) citing Kajanus (1912) stated that the presence of leaf marking is dominant over its absence and occured in accordance with the mono-hybrid formula at a ratio 3: 1. The recessive character of the lack of markings was further substantiated by the fact that plants having no markings whatever gave, when open-pollinated, progenies showing an overwhelming majority of plants possessing the usual central leaf markings.

Smith (1950) studied leaf markings in red clover from the genetic standpoint and called attention to the influence of age and shape on the expression of leaf markings.

This morphological character has been found interesting to investigate, on account of the two varieties Ottawa and Dollard which differ completely in this respect. Ottawa is a well known leaf marked variety, while Dollard can be easily identified by the absence of leaf markings.

Lasalle, resulting of the blend of Ottawa and Dollard in a proportion of 50: 50, was particularly investigated in order to see the behaviour when the two parents were left to hybridize normally.

Bearing in mind that leaf marking is dominant over its absence the expected ratio in the offspring is three leaf marked plants to one without leaf marking. So, in our test 75 per cent of the plants were expected to be leaf marked.

Only two categories have been recorded, namely: the presence or absence of leaf marking, and no genetical work was attempted to explain

the results.

Appendix Tables VII, VIII, IX and X give the details for Quebec strains, Lasalle and Kenland.

TABLE 20. PERCENTAGES OF LEAF MARKINGS IN QUEBEC, LASALLE AND KENLAND STRAINS COMPARED TO OTTAWA AND DOLLARD.

STOCK	LOCALITY	MARKED PLANTS %
Foundation(Dollard)	Macdonald College	0
Foundation(Ottawa)	C.Exp.Farm Ottawa	96
Quebec(late)	Gaspe Peninsula	93
Quebec(early)	Lower St.Lawrence	96
Quebec(early)	Eastern Townships	93
Quebec(early)	Montreal region and North Shore to Quebec city	93
Quebec(early)	Gatineau	93
Lasalle(registered)	West	53
Lasalle(registered)	East	91
Lasalle(year-of-seeding)	West	67
Kenland(breeder)	U.S.A.	94
Kenland(foundation, 1st generation)		93
Kenland(registered, 2nd generation)		92
Kenland(certified, 3rd generation)		92
Kenland(certified, 4th generation)		93

Quebec strains ranked first as far as leaf marked plants are concerned. Strains from Lower St.Lawrence were similar to Ottawa and the remainders very closed to. Lasalle (registered) from West was half way between Ottawa and Dollard, whereas Lasalle (registered) from East was 93 per cent leaf marked. On the other hand, Lasalle (year-of-seeding) was close to the expected percentage with 67 per cent marked plants. Explanations are difficult to give to clarify these situations. It is possible that fields for seed production were better isolated in the West than in the East, so that much less contamination was possible. Moreover, red clover being hybrid seed and a wide range of variation being observed in the growth types, it seems logical to expect such a range of variation in the appearance of leaf markings. Another explanation has been suggested by Dr Helgason, in a verbal communication, implying that the fact that Ottawa being earlier in blooming than Dollard could favor the appearance of leaf markings.

In Kenland strains, no appreciable difference has been noticed. Compared to Ottawa, Kenland is a variety highly characterized by the presence of leaf marks.

Section V - Winter Survival

Approximately half of each plot was cut at the end of August and the remainder in the beginning of November. About midway between cuttings all plants were individually examined carefully and graded good, fair or poor according to their relative healthiness. Those classed as poor were recorded as dead. In the case of dead plants, the cause of death (such as viruses, etc.), where known, was recorded. A similar examination and grading was done the following spring, in early May 1955. It is thus possible, by expressing in percentages the over-wintering survival of the respective strains and types, to compare the effects of cutting at the two widely separated dates.

Table 21 gives a summary of the results for the Quebec strains grouped by growth types.

It will be noted that the earlier cutting date (end of August) gave the better winter survival. The late maturing strains showed little difference between the two cutting dates. The effect of late cutting, however, was very marked in the early maturing strains, with a sharp drop in survival in almost every case.

The heavier winter mortality amongst the early maturing strains would seem to have some relation to the greater number of plants producing seed the first year, as compared with the "lates". The plant seems to spend much of its resources in setting seed and consequently does not accumulate sufficient food reserves for over wintering.

Table 22 gives a summary of the results for the Canadian strains grouped by growth types.

Table 22 shows very well the good performance of Dollard and Ottawa. A high percentage of surviving plants among all types can be noticed. Even made up with those two varieties, Lasalle behaved much differently from both parents. This better survival to winter shown by Ottawa and Dollard would likely indicate that they are better adapted to climatic conditions which prevail at Macdonald College. Moreover, Ottawa and Dollard are slightly later in maturity than Lasalle, Kenland and the Quebec strains, and that could help the plants to form reserves in their roots and favor a better winter survival.

Table 23 gives a summary of the results for U.S. strains grouped by growth types.

As shown in Table 23, the winter survival of Kenland red clover has been improved by a cutting at the end of August. Compared to Lasalle, Kenland had a winter survival markedly increased, and this is true for all the different seed stocks. Although Kenland red clover was developed under different climatic conditions, its good performance must be emphasized in order to show the real advantage of using known and improved varieties. If we compare Kenland with Quebec strains, known as being better adapted to climatic conditions, we can notice the much better field performance of Kenland of which plants were healthy and much less damaged by diseases such as mildew and viruses.

TABLE 21. OVER-WINTERING OF QUEBEC STRAINS FOLLOWING DIFFERENT CUTTING DATES.

STOCK	LOCALITY	TIME OF CUTTING	LIVING PLANTS Fall 54, Spring 55		PER CENT OF PLANTS THAT SURVIVED					
					0	I	II	III	IV	Total
			No.	No.	%	%	%	%	%	%
Late	(Gaspe Peninsula)	August	278	184	68.1	57.2	0.0	72.0	nil	66.2
		November	379	246	68.2	61.8	57.9	61.0	nil	65.2
Early	(Lower St.Lawrence)	August	230	135	77.8	84.6	65.6	55.5	47.8	58.7
		November	305	155	76.9	67.2	57.8	48.5	37.0	50.8
Early	(Eastern Townships)	August	155	81	nil	nil	70.7	50.0	25.0	52.1
		November	208	71	nil	nil	30.4	35.5	22.2	34.1
Early	(Montreal Region and North Shore to Quebec city)	August	521	257	28.0	39.3	54.9	46.8	50.2	48.9
		November	521	285	nil	35.7	48.2	39.8	47.9	41.2
Early	(Gatineau)	August	392	174	nil	35.5	48.4	45.2	18.9	44.5
		November	563	182	16.0	27.6	49.9	27.7	20.9	32.4

TABLE 22. OVER-WINTERING OF DOLLARD, OTTAWA AND LASALLE STOCKS, FOLLOWING DIFFERENT CUTTING DATES.

STOCK	TIME OF CUTTING	LIVING PLANTS Fall 54, Spring 55		PER CENT OF PLANTS THAT SURVIVED					
				0	I	II	III	IV	Total
		No.	No.	%	%	%	%	%	%
Foundation (Dollard)	August	155	117	83.3	90.9	74.6	70.0	100	75.5
	November	232	170	90.9	80.0	64.1	80.6	46.7	73.3
Foundation (Ottawa)	August	150	126	75.0	69.2	80.4	94.4	60.0	84.0
	November	230	170	64.7	76.5	81.0	76.2	70.2	73.9
Lasalle (Registered)	August	390	235	nil	72.1	49.6	62.5	50.9	60.2
	November	779	372	33.0	34.0	51.3	43.3	40.8	47.7
Lasalle (Year-of-seeding)	August	389	300	20.0	50.0	82.1	76.4	74.2	76.5
	November	779	600	nil	76.6	78.3	79.8	65.4	77.0

TABLE 23. OVER-WINTERING OF KENLAND STOCKS, FOLLOWING DIFFERENT CUTTING DATES.

STOCK	TIME OF CUTTING	LIVING PLANTS Fall 54,	Spring 55	PER CENT OF PLANTS THAT SURVIVED					
				0	I	II	III	IV	Total
		No.	No.	%	%	%	%	%	%
Kenland (Breeder)	August	78	65	nil	nil	88.9	80.0	100	83.3
	November	156	76	nil	100	51.3	48.9	33.3	48.7
Kenland (Foundation)	August	234	184	nil	nil	89.3	77.3	79.3	78.6
	November	467	304	nil	46.7	72.0	65.4	58.7	65.1
Kenland (Registered)	August	234	188	nil	66.7	75.9	84.7	76.4	80.3
	November	467	343	nil	66.7	73.7	75.6	63.5	73.4
Kenland (Certified)	August	232	172	nil	69.8	85.3	70.0	49.4	74.3
	November	456	313	nil	64.6	65.0	73.8	51.0	68.6

DISCUSSION

From the results of this year-of-seeding investigation on growth types of red clover, it appears that red clover is remarkably variable in its morphological expression.

Known as a perennial legume, red clover behaves generally as a biennial plant. It has been observed rather frequently that a good number of plants behave also as annuals, that is, they flower and set seed during the same growing season.

This morphological character was studied extensively by Bird (1948) and five major types of growth were distinguished within a strain or variety. These growth types based on the development of the rosette and the production of flowering stems in the year of establishment, were described by Steppler and Raymond (1954).

As far as the Quebec strains are concerned, they can be grouped under two headings. One class called late strains includes the strains having a percentage of Types 0 ranging from 39 to 86 per cent and Types I from 9 up to 32 per cent. The other class can be called early strains, and this is the great majority. Within the various early strains there is a great deal of difference: Types 0 ranging from 0 up to 12.1 per cent; Types I, from 0.6 to 16.0; Types II, 9.4 to 29.9; Types III, 40.0 to 79.0 and Types IV, from 2.4 up to 25.4

The two strains from the Eastern Townships are, without any doubt, the earliest strains with 95 per cent of Types II and III. They are followed by the Joliette and Gatineau strains with 90 per

cent of the same two types.

Ottawa and Dollard have been found very similar in the distribution of the growth types within the varieties. Diagram 15 shows a picture of the close agreement between the two curves.

Lasalle was found different from both parents: Ottawa and Dollard. In Lasalle Types II were particularly lower while Types III were higher than the parents. Lasalle (registered) had 26 per cent Types II and 58 per cent Types III compared with 35 per cent Types II and 45 per cent Types III for Dollard. Lasalle (year-of-seeding) was not much closer to Ottawa and Dollard. It had 26 per cent Types II and 61 per cent Types III. Comparing Types 0 in both Dollard and Lasalle (registered) and (year-of-seeding) it is noticed that Types 0 seem to disapear without any difference whether it is registered of year-of-seeding seed lots.

Kenland, as shown in Diagram 15, follows very closely the curve plotted for Lasalle. That means that Kenland differs from Ottawa and Dollard about the same way. Appendix Table VI shows the figures for the different seed stocks of Kenland. Kenland (breeder, foundation and registered) did not have any Types 0, and Types II and III were 21 and 62 per cent. Kenland (certified 3rd and 4th generation) had no Types 0 but Types I, II, III and IV were very close to Dollard with 8, 36, 45 and 6 per cent whereas Dollard had 9, 36, 45, 6 per cent for the corresponding Types. This difference shown between breeder, foundation, registered and certified Kenland would likely indicate a considerable change in composition or an alteration rather difficult to explain.

It could be due to the successive outcrossing with native or local strains where Kenland is being multiplied for marketing. It could be a matter of management because Kenland for seed production is grown under irrigation.

This wide variation observed, in the planting year, on this large population of red clover can be attributed mainly to two important factors: 1.- the genetic constitution of the plant which is the product of the cross-pollination, is responsible, to a very large extent, for this variation between plants within a strain; 2.- the environment which includes: weather conditions such as humidity, sunshine hours, temperature, drought period; soil fertility, management practices etc.

The genetic factor takes care of maintaining the characters of the species, while the environmental factors influence the development or the growth of the plant. This latter influence can be favorable or detrimental to the plants and this is reflected not only in the forage yield but also on the morphological development. Most of the workers agree that red clover grown under damp and cloudy conditions will produce a luxuriant mass of leaves. This has been particularly observed during the summer of 1954 which was rather wet and cloudy. The vegetative growth was really over the average.

To what extent a strain moved from Gaspe Peninsula to Macdonald College, will show some alterations or deviations, is hard to know.

Forage and seed yields of the various groups of strains show a rather surprising relationship. Yields taken in the year of

establishment indicate a variation in two directions. When the forage yield increase there is a corresponding decrease in the seed yield. As an example, the Quebec strains, in general, being the poorest forage yielders were, the best seed yielders. Kenland had a very good forage yield but the seed yield was rather poor.

Leaf markings generally characterize red clover populations. However the absence of leaf marks can be a morphological character selected for identifying varieties, and Dollard is a practical example.

Ottawa, Kenland and all the Quebec strains were leaf marked, with over 90 per cent of the plants having such marks.

Lasalle (registered) from West had only 53 per cent leaf marked plants, whereas Lasalle (registered) grown in Manotick, Ontario, had over 90 per cent leaf markings. This rather wide difference might be attributed to less outcrossing in the case of Lasalle produced in the West, but that 53 per cent is far from the expected norm-75 per cent of plants marked.

Lasalle, year-of-seeding stock, behaved much closer to the expected 75 per cent, with 67 per cent plants marked.

The over-wintering of the various strains submitted to two widely separated dates of cutting (August and November) indicated that the earlier the cutting the better the winter survival. That holds for the early strains, while the picture is somewhat different with the late strains. The cutting dates did not seem to influence

the over-wintering of the late strains.

Allen and Kuhn (1955), studying the effect on maintenance of stands and hay yields of various management treatments applied to seedling red clover, under Maryland conditions, concluded that:"If only a single clipping is made during the seedling year, the best time for this clipping is from mid-August to early September". They added also:"Management which included clipping of plots around the first of September, control of weeds and presence of overmature growth of the red clover resulted in highest carbohydrate root and crown reserves".

Torrie and Hanson (1955) studying the effects of cutting red clover the first year on stand and yield in the second year, reported that the effect of this practice varied from year to year, under Wisconsin conditions, depending on growing conditions during the seedling year, the severity of the winters, and other factors. Clipping in late August was sometimes very beneficial and was never harmful. Cutting on September 15 or later was injurious in three of four tests and never increased yields. In general, best results were obtained when the first year's growth was clipped Aug. 31 and the clippings removed from the field.

Those two experiments are in close agreement with our own observations. The plots clipped at the end of August made a very good growth following cutting, and replenished root reserves. The following spring (1955) the percentage of over-wintering plants was found higher among the plants clipped late in August (1954). So, under Macdonald College conditions, a clipping late in August (Aug.28), was beneficial.

SUMMARY AND CONCLUSIONS

Seed of red clover from different parts of Quebec, from the Prairies Provinces, and from four American States were sown and studied, in 1954, for characters related to plant types, in order to investigate the changes in composition which appear in the successive generations of varieties and strains of red clover.

The results of this year-of-seeding test are the following:

1 - The Quebec strains can be grouped into: a) very late type (North-eastern part of the Province); b) very early type (Western and central part of the Province).

2 - Lasalle, compared to both parents, Ottawa and Dollard, showed marked deviation in Types II and III. Registered lots as well as year-of-seeding lots of Lasalle were classified much earlier in type than Ottawa and Dollard.

3 - Kenland breeder stock was characterized by a high percentage of Types III. Successive generations, foundation, registered and certified, showed a decrease in Types III with an increase in Types II. Certified Kenland gave a curve similar to Dollard.

4 - Forage yields were low with Quebec strains, and much higher with Lasalle and Kenland.

5 - Seed yield showed a reverse picture. Quebec strains gave a very high seed yield whereas Lasalle and Kenland gave a much lower seed yield.

6 - Leaf markings, characterizing varieties and strains of red clover, were found rather low in registered Lasalle, due to the fact that one parent, Dollard, is a non-leaf-marked variety.

7 - Over-wintering of red clover under study, was favored by a cutting made at the end of August.

A one-year-test with a perennial plant such as red clover, highly characterized by its variability in types and behaviour in the field, is not sufficient to draw any sound conclusions. However, the following observations can be taken into consideration:

1 - From breeder stock, there is a shift in plant types into two main directions: a) Lasalle showed an increase in Types III which seems to indicate that the new variety is much earlier in maturity than Ottawa and Dollard; b) Kenland, on the other hand, showed a marked tendency to become similar to Ottawa and Dollard with each advance in the generation, as far as plant types and maturity are concerned. Those two tendencies were shown with only two varieties, Lasalle and Kenland, and explanations for them are still forthcoming.

2 - Consequently, there is urgent need for further investigations, specially on the following points:

a) methods and dates of seeding;

b) management practices in the seeding year, including different cutting dates;

c) the fact of collecting seed in the year of establishment in relation to over-wintering;

d) the behaviour of plants grown from seed collected in the year of seeding, year after year.

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APPENDIX TABLE I - QUEBEC STRAINS - CLASSIFICATION OF STRAINS FROM DIFFERENT REGIONS OF THE PROVINCE ON THE BASIS OF GROWTH TYPES, MACDONALD COLLEGE 1954.

STOCK	STRAIN No.	LOCALITY	No. OF PLANTS CLASSIFIED	PER CENT OF GROWTH TYPES				
				0	I	II	III	IV
				%	%	%	%	%
Local	3	Matane	180	86.7	9.4	2.2	1.7	0.0
	9	Témiscouata	179	39.1	19.5	20.6	20.1	0.7
	14	Bonaventure	153	42.5	32.7	18.3	6.5	0.0
	15	Bonaventure	144	61.8	22.2	13.2	2.8	0.0
	1	Charlevoix	175	12.6	16.0	25.8	40.0	5.6
	10	Témiscouata	179	3.8	7.6	21.2	57.7	9.7
	46	Kamouraska	181	0.0	1.1	9.4	64.1	25.4
	4	Compton	182	1.1	0.6	15.2	80.7	2.4
	5	Compton	181	0.0	0.0	14.8	79.0	6.2
	6	Joliette	179	0.0	1.7	16.7	70.4	11.2
	7	Joliette	182	0.0	1.1	21.4	73.1	4.4
	8	Joliette	182	0.0	1.1	29.9	63.4	13.6
	12	Joliette	173	0.5	3.5	14.5	68.8	12.7
	11	St-Maurice	174	1.1	5.2	15.8	67.6	10.3

APPENDIX TABLE I - (cont'd)

APPENDIX TABLE I - QUEBEC STRAINS - CLASSIFICATION OF STRAINS FROM DIFFERENT REGIONS OF THE PROVINCE ON THE BASIS OF GROWTH TYPES, MACDONALD COLLEGE 1954.

STOCK	STRAIN No.	LOCALITY	No. OF PLANTS CLASSIFIED	PER CENT OF GROWTH TYPES				
				0	I	II	III	IV
				%	%	%	%	%
Local	16	D.-Montagnes	172	1.7	5.2	14.0	65.0	14.1
	17	Argenteuil	149	0.0	6.0	24.8	61.0	8.2
	18	Gatineau	168	0.0	3.6	24.4	64.9	7.1
	19	Gatineau	160	0.0	3.1	22.5	66.9	7.5
	20	Gatineau	159	0.0	4.4	25.2	64.8	5.6
	21	Gatineau	145	0.5	3.5	18.7	73.8	3.5
	22	Gatineau	160	0.0	3.7	29.4	61.9	5.0
	23	Gatineau	163	0.0	2.5	18.0	75.2	4.3

APPENDIX TABLE II - QUEBEC STRAINS - CLASSIFICATION OF STRAINS FROM DIFFERENT REGIONS OF THE PROVINCE ON THE BASIS OF GROWTH TYPES ACCORDING TO YEARS PRODUCED ON THE SAME FARM, MACDONALD COLLEGE 1954.

YEARS	STRAIN No.	LOCALITY	No. OF PLANTS CLASSIFIED	PER CENT OF GROWTH TYPES				
				0	I	II	III	IV
				%	%	%	%	%
Between 20 and 25 years								
	5	Compton	181	0.0	0.0	14.8	79.0	6.2
	6	Joliette	179	0.0	1.7	16.7	70.4	11.2
	7	Joliette	182	0.0	1.1	21.4	73.1	4.4
	8	Joliette	182	0.0	1.1	29.9	63.4	13.6
	17	Argenteuil	149	0.0	6.0	24.8	61.0	8.2
	18	Gatineau	168	0.0	3.6	24.4	64.9	7.1
	19	Gatineau	160	0.0	3.1	22.5	66.9	7.5
	21	Gatineau	145	0.5	3.5	18.7	73.8	3.5
	22	Gatineau	160	0.0	3.7	29.4	61.9	5.0
Between 10 and 20 years								
	4	Compton	182	1.1	0.6	15.2	80.7	2.4
	12	Joliette	173	0.5	3.5	14.5	68.8	12.7
	16	D.-Montagnes	172	1.7	5.2	14.0	65.0	14.1
	20	Gatineau	159	0.0	4.4	25.2	64.8	5.6
	23	Gatineau	163	0.0	2.5	18.0	75.2	4.3

APPENDIX TABLE III - CANADIAN STRAINS - CLASSIFICATION OF LOTS OF LASALLE RED CLOVER ON THE BASIS OF GROWTH TYPES, MACDONALD COLLEGE 1954.

STOCK	STRAIN No.	LOCALITY	No. OF PLANTS CLASSIFIED	PER CENT OF GROWTH TYPES				
				0	I	II	III	IV
				%	%	%	%	%
Foundation (Dollard)	45	Macdonald College	387	4.3	9.3	35.4	44.8	6.2
Foundation(Ottawa)	44	Ottawa	380	5.5	7.9	32.9	46.4	7.3
Registered (West)	24	Flatbush, Alta	234	1.8	10.2	34.6	50.0	3.4
	25	Brooks, Alta	234	0.0	5.1	30.8	58.5	5.6
	26	Gr.Forks, B.C.	234	0.0	2.6	23.1	67.9	6.4
	27	Stead, Manitoba	234	1.3	3.4	33.3	55.6	6.4
Registered (East)	28	Manotick, Ont.	233	0.0	1.3	9.8	58.4	30.5
Year of seeding	29	Hayes, Alta	233	0.0	2.6	34.3	54.1	9.0
	30	Hayes, Alta	234	0.0	3.0	15.4	63.2	18.4
	31	Hayes, Alta	234	0.4	3.4	27.8	61.6	6.8
	32	Hayes, Alta	234	0.0	3.0	28.6	61.6	7.3
	33	Hayes, Alta	233	0.0	3.0	23.3	64.8	9.9

APPENDIX TABLE IV - UNITED STATES STRAINS - CLASSIFICATION OF LOTS OF KENLAND ON THE BASIS OF GROWTH TYPES, MACDONALD COLLEGE 1954.

STOCK	STRAIN No.	LOCALITY	No. OF PLANTS CLASSIFIED	PER CENT OF GROWTH TYPES				
				0	I	II	III	IV
				%	%	%	%	%
Breeder	34	Kentucky	234	0.0	1.3	23.5	65.4	9.8
Foundation (1st generation)								
	35	Idaho	234	0.0	2.1	18.4	66.7	12.8
	36	California	234	0.0	0.4	14.6	64.1	20.9
	37	Washington	233	0.0	1.3	20.2	68.7	9.8
Registered (2nd generation)								
	38	Idaho	234	0.0	0.4	18.8	64.6	16.2
	39	California	234	0.0	3.0	18.4	62.4	16.2
	40	Washington	234	0.0	3.9	26.6	56.6	12.9
Certified(3rd generation)								
	41	Idaho	229	0.0	9.2	31.9	54.1	4.8
	42	Washington	230	0.0	8.7	33.5	52.2	5.6
Certified (4th generation)								
	43	Idaho	228	0.0	6.6	39.0	47.4	7.0

APPENDIX TABLE V - UNITED STATES STRAINS - CLASSIFICATION OF LOTS OF KENLAND ON THE BASIS OF GROWTH TYPES, MACDONALD COLLEGE 1954.

STOCK	STRAIN No.	LOCALITY	No. OF PLANTS CLASSIFIED	PER CENT OF GROWTH TYPES				
				0	I	II	III	IV
				%	%	%	%	%
	35	Idaho	234	0.0	2.1	18.4	66.7	12.8
	38	Idaho	234	0.0	0.4	18.8	64.6	16.2
	41	Idaho	229	0.0	9.2	31.9	54.1	4.8
	43	Idaho	228	0.0	6.6	39.0	47.4	7.0
	37	Washington	233	0.0	1.3	20.2	68.7	9.8
	40	Washington	234	0.0	3.9	26.6	56.6	12.9
	42	Washington	230	0.0	8.7	33.5	52.2	5.6
	36	California	234	0.0	0.4	14.6	64.1	20.9
	39	California	234	0.0	3.0	18.4	62.4	16.2
	34	Kentucky	234	0.0	1.3	23.5	65.4	9.8

APPENDIX TABLE VI - SUMMARY - CLASSIFICATION OF STRAINS FROM DIFFERENT SOURCES ON THE BASIS OF GROWTH TYPES, MACDONALD COLLEGE 1954.

STOCK	LOCALITY	No. OF PLANTS CLASSIFIED	PER CENT OF GROWTH TYPES				
			0	I	II	III	IV
			%	%	%	%	%
Local (late)	Quebec	656	57	21	14	8	0
Local (early)	Quebec	3064	2	5	19	67	7
Lasalle, Registered (West and East)	Canada	1169	1	5	26	58	10
(Year-of-seeding)	Alberta	1168	0	3	26	61	10
Foundation (Dollard)	Quebec	387	4	9	36	45	6
Foundation (Ottawa)	Ontario	380	6	8	33	46	7
Kenland (Breeder)	U. States	234	0	1	24	65	10
(Foundation, 1st generation)		701	0	2	18	67	13
(Registered, 2nd generation)		702	0	2	22	61	15
(Certified, 3rd generation)		459	0	9	33	53	5
(Certified, 4th generation)		228	0	7	39	47	7

APPENDIX TABLE VII - QUEBEC STRAINS - ACTUAL AND RELATIVE GREEN MATTER AND SEED YIELD WITH PERCENTAGES OF MARKED PLANTS FOR QUEBEC STRAINS, MACDONALD COLLEGE, 1954.

STOCK	STRAIN No.	LOCALITY	GREEN MATTER YIELD/78 PL. actual	relative (1)	SEED YIELD/50 HEADS actual	relative (2)	T-K-W	MARKED plants
			kg	%	grams		grams	%
Foundation (Dollard)	45	Macdonald	17.06	100	----	----	----	0
Foundation (Ottawa)	44	Ottawa	19.78	116	3.00	100	1.4002	96
Local (late)	3	Matane	7.78	46	----	----	----	89
	9	Témiscouata	13.59	80	----		----	96
	14	Bonaventure	11.12	65	----	----	----	95
	15	Bonaventure	9.26	54	----	----	----	91
Local (early)	1	Charlevoix	15.48	91	8.40	215	1.5240	96
	10	Témiscouata	16.20	95	7.18	184	1.5190	97
	46	Kamouraska	14.32	84	5.59	143	1.4776	95
	4	Compton	15.80	93	6.63	170	1.4564	93
	5	Compton	19.28	113	6.32	162	1.4784	93

(1) Relative forage yield based on Dollard.
(2) Relative seed yield based on Ottawa.

APPENDIX TABLE VII (cont'd)

APPENDIX TABLE VII - QUEBEC STRAINS - ACTUAL AND RELATIVE GREEN MATTER AND SEED YIELD WITH PERCENTAGES OF MARKED PLANTS FOR QUEBEC STRAINS, MACDONALD COLLEGE, 1954.

STOCK	STRAIN No.	LOCALITY	GREEN MATTER YIELD/78 PL. actual	relative(1)	SEED YIELD/50 HEADS actual	relative(2)	T-K-W	MARKED plants
			kg	%	grams		grams	%
Local (early)								
	6	Joliette	16.48	97	6.15	158	1.4830	96
	7	Joliette	14.18	83	6.32	162	1.4600	87
	8	Joliette	17.35	102	8.22	211	1.5828	91
	12	Joliette	15.28	90	8.25	212	1.4764	93
	11	St-Maurice	15.87	93	6.38	163	1.6062	95
	16	D.Montagnes	17.07	100	7.22	185	1.5146	91
	17	Argenteuil	14.06	82	8.07	207	1.4978	97
	18	Gatineau	16.51	97	6.47	166	1.6684	91
	19	Gatineau	17.22	101	6.84	175	1.4308	93
	20	Gatineau	14.80	87	8.05	206	1.5462	97
	21	Gatineau	15.24	89	6.61	169	1.6574	92
	22	Gatineau	15.48	91	7.76	199	1.4044	92
	23	Gatineau	17.07	100	7.88	202	1.6482	95

(1) As before.
(2) As before.

APPENDIX TABLE VIII - QUEBEC STRAINS - ACTUAL AND RELATIVE GREEN MATTER AND SEED YIELD WITH PERCENTAGES OF MARKED PLANTS FOR QUEBEC STRAINS, ACCORDING TO YEARS PRODUCED ON THE SAME FARM, MACDONALD COLLEGE 1954.

YEARS	STRAIN No.	LOCALITY	GREEN MATTER YIELD/78 PL. actual	relative(1)	SEED YIELD/50 HEADS actual	relative(2)	T-K-W	MARKED plants
			kg	%	grams		grams	%
Between 20 and 25 years								
	5	Compton	19.28	113	6.32	162	1.4784	93
	6	Joliette	16.48	97	6.15	158	1.4830	96
	7	Joliette	14.18	83	6.32	162	1.4600	87
	8	Joliette	17.35	102	8.22	211	1.5822	91
	17	Argenteuil	14.06	82	8.07	207	1.4978	97
	18	Gatineau	16.51	97	6.47	166	1.6684	91
	19	Gatineau	17.22	101	6.84	175	1.4308	93
	21	Gatineau	15.24	89	6.61	169	1.6574	92
	22	Gatineau	17.07	100	7.76	199	1.4044	92
Between 10 and 20 years								
	4	Compton	15.80	93	6.63	170	1.4564	93
	12	Joliette	15.28	90	8.25	212	1.4764	93
	16	D.-Montagnes	17.07	100	7.22	185	1.5146	91
	20	Gatineau	14.80	87	8.05	206	1.5462	97
	23	Gatineau	17.07	100	7.88	202	1.6482	92

(1) As before.
(2) As before.

APPENDIX TABLE IX - CANADIAN STRAINS - ACTUAL AND RELATIVE GREEN MATTER AND SEED YIELD WITH PERCENTAGES OF MARKED PLANTS FOR LASALLE, MACDONALD COLLEGE 1954.

STOCK	STRAIN No.	LOCALITY	GREEN MATTER YIELD/78 PL. actual	relative(1)	SEED YIELD/50 HEADS actual	relative(2)	T-K-W	MARKED plants
			kg	%	grams		grams	%
Lasalle (Registered West)								
	24	Flatbush, Alta	34.10	200	7.35	188	1.6440	38
	25	Brooks, Alta	34.89	204	8.05	206	1.6630	58
	26	Gr.Forks, B.C.	36.35	213	8.74	224	1.5868	67
	27	Stead, Man.	35.38	207	7.35	188	1.4634	51
(Registered East)								
	28	Manotick, Ont.	22.90	134	8.95	229	1.5560	91
(Year of seeding)								
	29	Hayes, Alta	28.87	169	7.64	193	1.5406	67
	30	Hayes, Alta	26.13	153	6.23	160	1.3718	70
	31	Hayes, Alta	28.56	167	5.42	139	1.4108	66
	32	Hayes, Alta	27.93	164	7.76	199	1.4356	68
	33	Hayes, Alta	32.50	190	3.31	85	1.4956	62

(1) As before.
(2) As before.

APPENDIX TABLE X - UNITED STATES STRAINS - ACTUAL AND RELATIVE GREEN MATTER AND SEED YIELD WITH PERCENTAGES OF MARKED PLANTS FOR KENLAND, MACDONALD COLLEGE 1954.

STOCK	STRAIN No.	LOCALITY	GREEN MATTER YIELD/78 PL. actual	relative(1)	SEED YIELD/50 HEADS actual	relative(2)	T-K-W	MARKED plants
			kg	%	grams		grams	%
Breeder								
	34	Kentucky	33.63	197	5.12	131	1.3288	94
Foundation (1st generation)								
	35	Idaho	31.93	187	4.79	123	1.4666	94
	36	California	24.33	143	5.65	145	1.4954	92
	37	Washington	29.58	173	2.74	70	1.4204	94
Registered (2nd generation)								
	38	Idaho	29.90	175	6.27	161	1.5012	91
	39	California	23.20	136	6.61	169	1.5704	91
	40	Washington	22.78	133	5.66	145	1.4774	94
Certified (3rd generation)								
	41	Idaho	22.02	129	2.30	59	1.2712	94
	42	Washington	25.43	149	4.52	116	1.3334	91
Certified (4th generation)								
	43	Idaho	23.48	138	4.98	128	1.3562	93

(1) As before.
(2) As before.

APPENDIX TABLE XI - UNITED STATES STRAINS - ACTUAL AND RELATIVE GREEN MATTER AND SEED YIELD WITH PERCENTAGES OF MARKED PLANTS FOR KENLAND GROUPED ACCORDING TO THE STATES WHERE THE SEED HAS BEEN PRODUCED, MACDONALD COLLEGE 1954

STOCK	STRAIN No.	LOCALITY	GREEN MATTER YIELD/78 PL. actual	relative(1)	SEED YIELD/50 HEADS actual	relative(2)	T-K-W	MARKED plants
			kg	%	grams		grams	%
	35	Idaho	31.93	187	4.79	123	1.4666	94
	38	Idaho	29.90	175	6.27	161	1.5012	91
	41	Idaho	22.02	129	2.30	59	1.2712	94
	43	Idaho	23.48	138	4.98	128	1.3562	93
	37	Washington	29.58	173	2.74	70	1.4204	94
	40	Washington	22.78	133	5.66	145	1.4774	94
	42	Washington	25.43	149	4.53	116	1.3334	91
	36	California	24.33	143	5.65	145	1.4954	92
	39	California	23.28	136	6.61	169	1.5704	91
	34	Kentucky	23.63	197	5.12	131	1.3288	94

(1) As before.
(2) As before.

APPENDIX TABLE XII - SUMMARY - ACTUAL AND RELATIVE GREEN MATTER AND SEED YIELD WITH PERCENTAGES OF MARKED PLANTS FOR THE STRAINS OF DIFFERENT SOURCES, MACDONALD COLLEGE 1954.

STOCK	LOCALITY	GREEN MATTER YIELD/78 PL. actual	relative(1)	SEED YIELD/50 HEADS actual	relative(2)	T.K.W	MARKED plants
		kg	%	grams		grams	%
Local(late)	Quebec	10.43	61	----	----	----	93
Local(early)	Quebec	16.28	95	7.05	181	1.5147	94
Lasalle, Registered(West and East)							
	Canada	32.72	192	8.09	207	1.5827	72
(Year of seeding)	Alberta	28.78	169	6.05	155	1.4508	67
(Mean)		30.76	180	7.07	181	1.5168	64
Foundation (Dollard)	Quebec	17.06	100	----	----	----	0
Foundation (Ottawa)	Ontario	19.78	116	3.90	100	1.4002	96
Kenland (Breeder)	U. States	33.63	197	5.12	131	1.3288	94
Foundation(1st generation)		28.61	168	4.39	112	1.4608	93
Registred(2nd generation)		25.32	148	6.18	158	1.5163	92
Certified(3rd generation)		23.72	139	3.41	87	1.3023	92
Certified(4th generation)		23.48	138	4.86	128	1.3562	92
Mean		26.64	156	4.86	125	1.4221	93

APPENDIX TABLE XIII - QUEBEC STRAINS - OVER-WINTERING OF QUEBEC STRAINS, FOLLOWING DIFFERENT CUTTING DATES.

STOCK	LOCALITY	TIME OF CUTTING	LIVING PLANTS Fall 54, Spring 55		PER CENT OF PLANTS THAT SURVIVED					
					0	I	II	III	IV	Total
			No.	No.	%	%	%	%	%	%
Late 3	Matane	August	77	58	77.8	50.0	0.0	0.0	----	75.3
		November	104	65	63.1	61.5	75.0	50.0	----	62.5
9	Témiscouata	August	76	47	68.9	66.7	69.2	44.4	----	61.8
		November	103	66	63.4	85.0	70.0	33.3	----	64.1
14	Bonaventure	August	61	40	66.7	82.3	38.4	100.0	----	66.7
		November	92	58	68.6	54.5	46.6	100.0	----	63.0
15	Bonaventure	August	64	39	59.1	75.0	77.8	----	----	60.9
		November	80	57	77.7	75.0	40.0	----	----	71.3
Early 1	Charlevoix	August	76	52	88.9	69.2	75.0	60.0	50.0	68.4
		November	99	52	53.8	80.0	56.0	50.0	0.0	52.5
10	Témiscouata	August	77	48	66.7	100.0	56.2	65.9	45.4	62.3
		November	102	57	100.0	54.5	77.3	46.3	45.4	55.9
46	Kamouraska	August	77	35	----	----	0.0	40.8	48.0	45.4
		November	104	46	----	----	40.0	49.2	28.6	44.2

QUEBEC STRAINS (cont'd)

APPENDIX TABLE XIII - QUEBEC STRAINS - OVER-WINTERING OF QUEBEC STRAINS, FOLLOWING DIFFERENT CUTTING DATES.

STOCK	LOCALITY	TIME OF CUTTING	LIVING PLANTS Fall 54, Spring 55		PER CENT OF PLANTS THAT SURVIVED					
					0	I	II	III	IV	Total
			No.	No.	%	%	%	%	%	%
16	D.-Montagnes	August	73	22	100	0.0	45.0	24.5	35.7	30.1
		November	99	32	0.0	0.0	26.7	39.7	30.0	32.3
17	Argenteuil	August	66	25	----	50.0	35.0	35.0	60.0	37.9
		November	83	31	----	40.0	29.4	38.9	42.8	37.3
Early 18	Gatineau	August	71	21	----	0.0	35.0	30.0	0.0	29.6
		November	97	19	----	40.0	37.5	10.2	22.2	19.6
19	Gatineau	August	64	27	----	33.3	50.0	42.1	28.6	42.2
		November	96	29	----	50.0	25.0	31.9	20.0	30.2
20	Gatineau	August	63	28	----	40.0	62.5	39.4	25.0	44.4
		November	96	34	----	0.0	66.7	27.7	0.0	35.4
21	Gatineau	August	69	36	0.0	40.0	50.0	53.1	60.0	52.2
		November	76	26	100	0.0	40.0	31.7	0.0	34.2
22	Gatineau	August	65	35	----	50.0	56.7	56.4	0.0	53.8
		November	95	39	----	75.0	58.8	32.3	66.7	41.0
23	Gatineau	August	60	27	----	50.0	36.3	50.0	0.0	45.0
		November	103	35	----	0.0	71.4	32.2	16.6	33.9

QUEBEC STRAINS (cont'd)

APPENDIX TABLE XIII - QUEBEC STRAINS - OVER-WINTERING OF QUEBEC STRAINS, FOLLOWING DIFFERENT CUTTING DATES.

STOCK	LOCALITY	TIME OF CUTTING	LIVING PLANTS Fall 54, Spring 55		PER CENT OF PLANTS THAT SURVIVED					
					0	I	II	III	IV	Total
			No.	No.	%	%	%	%	%	%
Early 4	Compton	August	78	33	----	----	72.2	38.1	25.0	42.3
		November	104	33	----	----	17.6	34.5	0.0	31.7
5	Compton	August	77	48	----	----	69.2	62.9	0.0	62.3
		November	104	38	----	----	42.8	37.0	22.2	36.5
Early 6	Joliette	August	78	46	----	100	80.0	52.9	50.0	58.9
		November	101	55	----	100	66.7	49.3	50.0	54.4
7	Joliette	August	78	41	----	0.0	60.0	53.1	25.0	52.6
		November	104	44	----	50.0	48.3	37.7	75.0	42.3
8	Joliette	August	78	46	----	0.0	66.7	57.4	53.8	58.9
		November	104	37	----	0.0	54.5	33.8	16.6	35.6
12	Joliette	August	72	36	----	75.0	50.0	45.8	80.0	50.0
		November	101	43	----	50.0	45.4	43.7	35.3	42.6
11	St-Maurice	August	76	41	100	50.0	47.6	58.9	45.4	53.9
		November	98	43	----	60.0	66.7	35.6	85.7	43.9

APPENDIX TABLE XIV - CANADIAN STRAINS - OVER-WINTERING OF CANADIAN STRAINS, FOLLOWING DIFFERENT CUTTING DATES.

STOCK	LOCALITY	TIME OF CUTTING	LIVING PLANTS Fall 54, Spring 55		PER CENT OF PLANTS THAT SURVIVED					
					0	I	II	III	IV	Total
			No.	No.	%	%	%	%	%	%
Foundation (Dollard)		August	155	117	83.3	90.9	74.6	70.0	100	75.5
		November	232	170	90.9	80.0	64.1	80.6	46.7	73.3
Foundation (Ottawa)		August	150	126	75.0	69.2	80.4	94.4	60.0	84.0
		November	230	170	64.7	76.5	81.0	70.2	69.2	73.9
Lasalle (Registered)	Alberta	August	78	53	0.0	85.7	60.8	65.9	100	67.9
		November	156	99	100	82.3	72.4	50.7	50.0	63.5
24										
25	Alberta	August	78	52	----	75.0	68.2	66.7	50.0	66.7
		November	156	86	----	50.0	60.0	56.2	22.2	55.1
26	B.C.	August	78	46	----	100	64.7	64.1	0.0	58.9
		November	156	75	----	80.0	50.0	45.1	58.3	48.1
27	Manitoba	August	78	43	0.0	100	54.5	52.0	66.7	55.1
		November	156	83	66.7	80.0	55.3	50.0	50.0	53.2

CANADIAN STRAINS (cont'd)

APPENDIX TABLE XIV - CANADIAN STRAINS - OVER-WINTERING OF CANADIAN STRAINS, FOLLOWING DIFFERENT CUTTING DATES.

STOCK	LOCALITY	TIME OF CUTTING	LIVING PLANTS Fall 54, Spring 55		PER CENT OF PLANTS THAT SURVIVED					
					0	I	II	III	IV	Total
			No.	No.	%	%	%	%	%	%
Lasalle (Registered) 28	Ontario	August	78	41	----	0.0	0.0	63.8	37.9	52.6
		November	155	29	----	66.7	19.0	14.6	23.8	18.7
Lasalle (Year-of-s.) 29	Alberta	August	77	55	----	0.0	83.3	66.7	62.5	71.4
		November	156	112	----	66.7	76.8	70.4	61.5	71.8
30	Alberta	August	78	44	----	0.0	85.7	53.8	33.3	56.4
		November	156	103	----	100	72.7	67.7	48.3	66.0
31	Alberta	August	78	65	100	0.0	83.3	83.6	75.0	83.3
		November	156	130	0.0	75.0	65.9	96.6	58.3	83.3
32	Alberta	August	78	65	----	100	78.2	83.7	100	83.3
		November	156	126	----	75.0	88.6	82.2	71.4	80.7
33	Alberta	August	78	71	----	100	80.0	94.0	100	91.0
		November	155	129	----	66.7	87.5	82.2	87.5	83.2

APPENDIX TABLE XV -UNITED STATES STRAINS - OVER-WINTERING OF STATES STRAINS, FOLLOWING DIFFERENT CUTTING DATES.

STOCK	LOCALITY	TIME OF CUTTING	LIVING PLANTS Fall 54, Spring 55		PER CENT OF PLANTS THAT SURVIVED					
					0	I	II	III	IV	Total
			No.	No.	%	%	%	%	%	%
Kenland	Kentucky	August	78	65	----	0.0	88.9	80.0	100	83.3
34		November	156	76	----	100	51.3	48.9	33.3	48.7
Kenland (Foundation)	Idaho	August	78	53	----	0.0	76.9	67.8	55.5	67.9
		November	156	94	----	40.0	60.0	64.0	47.6	60.3
35										
36	California	August	78	65	----	0.0	100	82.3	82.3	83.3
		November	156	105	----	0.0	76.0	68.7	56.2	67.3
37	Washington	August	78	66	----	0.0	90.9	82.0	100	84.6
		November	155	105	----	100	80.0	63.6	72.2	67.7
Kenland (Registered)	Idaho	August	78	59	----	100	68.7	76.1	80.0	75.6
		November	156	111	----	0.0	82.1	70.5	60.8	71.1
38										
39	California	August	78	67	----	50.0	89.5	88.0	71.4	85.9
		November	156	121	----	100	75.0	80.2	67.7	77.6
40	Washington	August	78	62	----	50.0	69.6	90.0	77.7	79.5
		November	155	111	----	100	64.1	76.1	61.9	71.6
Kenland (Certified)	Idaho	August	77	62	----	42.8	92.8	82.0	33.3	80.5
		November	152	113	----	50.0	68.9	83.5	50.0	74.3
41										
42	Washington	August	78	66	----	100	86.4	83.3	75.0	84.6
		November	152	104	----	68.7	61.8	73.6	66.7	68.4
43	Idaho	August	76	44	----	66.7	76.7	44.7	40.0	57.9
		November	152	96	----	75.0	64.4	64.3	36.3	63.1