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"ASTEROID"

Thesis for M. Agr. Sc.

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PERSISTENCY IN CRESTED DOGSTAIL.  
ITS RELATION TO ORIGIN, FLOWERING  
DATE, SEED COLOUR AND GERMINATION  
CAPACITY OF NEW ZEALAND SEED  
SAMPLES.

7 1932  
Sydenham

## INTRODUCTION.

Crested dogstail is a valuable pasture grass, and is sown under a wide range of soil conditions. It is essentially a bottom grass. It is very palatable to sheep and thrives well under conditions of continuous close grazing. It does not, however, feature to any large extent in dairying land. It shows very great powers of re-establishment by seeding even under adverse seed-bed conditions, and it is this re-establishment which enables it to persist in a pasture for a number of years. Such re-establishment should not occur each Autumn after the plants have seeded and died or are so low in vitality that they remain only as worthless vestiges. This is a weakness of crested dogstail which it is desirable to eliminate. What it requires is a vigorous turf which will, on the advent of Autumn rains, spring into a highly productive sward vigorous enough to check any inferior grasses or weeds which may attempt to gain a footing.

Much crested dogstail seen on the New Zealand market is produced under a system of arable farming. In ~~North~~ Sandon and Southland, the two main crested dogstail seed producing areas in New Zealand, crested dogstail leys will not maintain a pure clean sward for more than about two years if a seed crop is taken in the first harvest year. The area will become overrun with weeds and inferior grasses as the dogstail dies out. However older fields in both districts are shut up for a period of four to six weeks and the seed taken with a stripper. It seems possible theoretically that stripped seed would eventually give an improved product where stripping is continued yearly, as the more annual plants would not be permitted to re-seed while the more perennial forms would continue to contribute after the others had died out. As the main permanent pastures are produced from these short-lived strains stripped samples cannot immediately be expected to show an improvement on them.

Crested dogstail although a grass producing a high proportion of stem to leaf has given relatively good yields of leaf in the third and fourth harvest years. From Aberystwyth records (Series H. No. 10) we obtain the following figures showing the proportion of leaf present in the crested dogstail herbage :-

1st year	26% leaf.
2nd year	51% leaf.
3rd year	78% leaf
4th year	61% leaf.

These figures strongly suggest that leafiness is related to permanency, and also that the excessive amount of stalk in many old pastures largely dominated by crested dogstail is primarily due to abundant self seeding and thus to the presence each year of a large number of first harvest plants.

If the value of crested dogstail is to be enhanced it is essential that reasonably permanent strains be employed in permanent pasture sowings. In the trial subsequently described the technique was such that no re-seeding was permitted so that the trial was well designed to test the various samples for persistency.

In view of the marked differences in persistency shown by different samples of crested dogstail the investigation was undertaken to ascertain the relative merits of seed produced in the main seed producing areas in New Zealand. At the same time data relative to the same samples have been analysed statistically to discover any correlations that might exist and which might prove of value in the seed trade.

## TECHNIQUE.

Of the samples of crested dogstail seed submitted during 1927-1929 to the Seed Testing Station, Department of Agriculture, to be tested for germination some were subsequently sown in the Massey Agricultural College experimental plots in Areas 5 and 8. The represent seed from all districts in New Zealand.

Area 5 was sown down in the Spring of 1929 on ground that had laid dormant over winter. Area 8 was sown in April 1930 following potatoes.

Each area was subdivided into a number of plots 1/500 acre in extent and in each was sown 18.1 grammes of seed (equivalent to 20 pounds per acre). No manure was applied at the time of sowing nor to the previous crop.

The unused portion of the seed sample was set aside for later reference. (See section dealing with seed colour in relation to germination).

The layout of the plots was such that in both Areas 5 and 8 there were four rows of plots. Two rows were adjacent to one another and the two double rows were separated by a grass strip. The double rows were surrounded by mown grass paths. Figure 1 represents the layout of Areas five and eight. Each plot was marked off and subdivided into three by timothy drills which persisted throughout the experiment and served to delineate the plots. All lines in Figure 1 represent these Timothy drills.

Each of the three sub-plots has been submitted to one of three treatments. The two adjacent ones of each double row of plots have been cut each week throughout the year, a treatment to represent continuous sheep grazing. The outside sub-plots of each row have been mown each week but a hay crop has been taken. The remaining sub-plots have been cut every third week to represent rotational grazing. The mowings were made with an ordinary type hand lawn mower cutting to about one inch from ground and the cut



herbage was collected and removed. No stock was permitted onto the area.

The hay was cut with a scythe about the end of the third week in December at the flowering time of the crested dogtail but before any of its seed had a chance to ripen and fall.

The hedges were closely trimmed to about two feet from the ground.

Applications of 2 cwt. of ammoniated superphosphate were applied to both areas before closing up for hay, in the years previous to 1931.

#### Method of Sowing and Samples Sown.

The two Areas were subdivided into plots by garden lines and the samples were sown broadcast within the areas so marked off. When all samples had been sown a Planet Junior sowing a drill of Timothy seed was run along the lines so that the different plots would be marked off by Timothy drills. In addition each plot was subdivided into three by two Timothy drills running the whole length of each row of plots. Such planting was done under supervision of the Department of Agriculture.

Area 5 contained thirty-three commercial Sandon and one hundred and twenty-eight commercial Southland together with seven commercial miscellaneous samples, and a Sandon and Southland sample was sown alternately so long as the Sandon samples remained with the exception that Plots 2 and 3 were Sandon and in Plots 1, 9 and 25 a miscellaneous sample replaced a Sandon sample. Also Plots 145, 152, 153 and 154 were miscellaneous commercial samples. (See Appendix, Table 4).

In Plot 8 sixteen commercial Sandon, ninety-eight commercial Southland, and thirty-eight miscellaneous commercial and experimental samples were sown. (See Appendix, Table 4). A row of thirty-eight plots including twenty Southland, six Sandon and twelve miscellaneous plots was duplicated. The remaining seventy-six plots were not duplicated nor were the Southland and Sandon

samples planted alternately.

#### Method of Counting Crested Dogtail Plants.

The method of counting crested dogtail plants in the parts of the plots under different treatment is to count all crested dogtail plants within an area of twelve inches by three inches, the area ~~area~~ enclosed by wires suspended in a wooden frame, which, when pressed to the ground is held there by four spikes. Five of such areas, taken more or less at random, are counted to each sub-plot so that crested dogtail plants are counted on  $1\frac{1}{2}$  square feet. All reference to plot counts thus refers to this  $1\frac{1}{2}$  square foot area, the total of the five counts.  $1\frac{1}{2}$  square feet represent rather more than  $1/25$  of the total of each sub-plot so should be a reliable indication of the number of plants present.

#### Discussion of Lawnmower Treatments.

Constant mowing, always cutting to the same level and non-selective, undoubtedly results in a botanical composition different to that produced under grazing conditions. However with crested dogtail being more of a bottom grass than certain other grasses, notably perennial rye and cocksfoot, it should not be so severely pruned by the mowings as these grasses. The reduction in numbers should be caused more by the inherent condition of non-persistency, as well as by the competition with other species, than by the constant cutting.

Since a pure sowing of crested dogtail was made it is the non-persistent samples which have permitted the greater development of volunteer growth. The lawn-mower treatments, in addition to cutting the herbage at different stages of growth, have facilitated invasion by volunteers, and of these especially white clover. The different lengths and densities of growth under the different treatments have afforded varying amounts of competition to the remaining crested dogtail plants. Under such treatment only the more persistent plants will survive. Hence the lawnmower treatment

is well suited to select these out.

Early in the introduction it was stated that crested dogstail was essentially a grass for close-grazed sheep pasture land and that it did not feature to any large extent on dairying land. The average counts from the plots do not entirely substantiate these statements. These average figures are given in Table 1. They show that the average counts of the Sandon and Southland plots mown every third week are intermediate between the counts under weekly mowing and hay treatments in Area 5; but in Area 8 such does not hold. The greatest number of plants persist under the 3-weekly mowing treatment, that is under conditions of <sup>on</sup>larger growth. This anomalous condition might be explained by differences in the density of white clover in the two areas. Thus in Area 8 under the weekly-mowing treatment the growth of white clover has been very dense while that under the 3-weekly-mowing treatment has not been so dense. It may be that the crested dogstail plants under the weekly-mowing treatment suffered greater competition from the short dense growth than the plants subjected to the 3-weekly mowing treatment did from the longer growth. In Area 5 on the other hand the growth of white clover on the weekly-mown plots was not so dense as that under similar treatment in Area 8. Had sheep grazing replaced the weekly-mowing in Area 8 no doubt the growth of white clover would never have been allowed to become so aggressive and the crested dogstail plants under such conditions would have maintained their numbers better.

We can safely conclude that the results of the three lawn mower treatments will not be truly indicative of those of the grazing conditions they are supposed to represent. Hence we cannot conclude that the treatments do represent animal grazing: rather do they offer crested dogstail different amounts of competition under which the more persistent plants will survive. It is very probable that more crested dogstail plants would have persisted

had stock been allowed to graze on the area. The treading by their feet and the return of excreta to the soil would have helped to thicken the sward and grazing would have tended to limit the aggressiveness of the white clover - all <sup>3</sup> factors would have helped to maintain the numbers of crested dogstail plants.

Whatever the disadvantages of the lawnmower treatment one point in its favour is that the treatment can be uniform and that it makes possible the number of different treatments on so small an area. Stock grazing was impracticable in view of the small extent of the two Areas devoted to the trial and the number of different treatments involved. The lawnmower remained as the only method of removing the weekly and 3-weekly growth.

RESULTS.

THE RELATIVE PERSISTENCY OF SANDON AND SOUTHLAND  
SAMPLES.

During December 1931 and January and early February 1932 counts were made of the crested dogstail plants in  $1\frac{1}{4}$  square feet of the three treatments of each plot in Areas 5 and 8 (See Appendix, Table 1). Statistics were applied to these figures and the average counts of crested dogstail plants in the three treatments of Sandon and Southland plots in both Areas 5 and 8 are given in Table 1. The origin of the various samples is given in Table 4 of the Appendix.

TABLE 1.

<i>Area</i> <u>Plot</u> <u>No.</u>	<u>Origin</u>	Average Counts Under :-		
		Weekly mowing	3-weekly mowing	Hay Treatment
5	Southland	21.39 <del>8</del> ± 0.74 <del>1</del>	12.82 <del>0</del> ± 0.49 <del>8</del>	4.15 <del>8</del> ± 0.41 <del>0</del>
5	Sandon	15.60 <del>8</del> ± 1.23 <del>8</del>	10.15 <del>8</del> ± 0.89 <del>8</del>	2.60 <del>8</del> ± 0.53 <del>0</del>
8	Southland	24.66 <del>8</del> ± 0.61 <del>8</del>	30.03 <del>1</del> ± 0.87 <del>0</del>	19.43 <del>0</del> ± 0.73 <del>0</del>
8	Sandon	10.68 <del>0</del> ± 0.29 <del>0</del>	21.87 <del>5</del> ± 0.11 <del>1</del>	7.62 <del>5</del> ± 0.67 <del>8</del>

The differences in average counts for Sandon and Southland sub-plots are all significant in Area 8 in favour of Southland sub-plots: while in Area 5 the difference is significant only in the case of the weekly-mowing treatment. The number of plants in the counts is taken as representing the relative persistency of the samples.

Discussion.

Since Area 8 was more recently sown than Area 5 (the counts of Area 8 in Table 1 were made approximately twenty months after sowing and those for Area 5 approximately twenty-seven months

after sowing) it is apparent that in the earlier stages Southland samples produce the greater number of plants under all treatments; but that at later stages (Area 5 which has survived one harvest year more than Area 8) while the difference maintains its significance under weekly mowing conditions it fails to do so under 3-weekly and hay treatments. This is partly confirmed by counts made by Jacques in February, March and April of 1931 about fifteen months after sowing (unpublished results - see Appendix, Table 2). Statistics were applied to these counts and the average figures, given in Table 2, show that weekly and 3-weekly differences are significant in favour of Southland samples but no significant difference is shown in the hay treatments.

TABLE 2.

<i>area</i> Plot No.	Origin	Average Counts Under :-		
		Weekly mowing	3-weekly mowing	Hay treatment.
5	Southland	102.38 <del>±</del> + 3.53 <del>±</del>	36.20 <del>±</del> + 2.38 <del>±</del>	25.07 <del>±</del> + 1.96 <del>±</del>
5	Sandon	89.27 <del>±</del> + 5.18 <del>±</del>	25.48 <del>±</del> + 2.41 <del>±</del>	23.36 <del>±</del> + 2.01 <del>±</del>

It is intended to obtain further counts from Area 8 to see if this initial difference in favour of Southland samples is normal, and to see if at later stages the difference only maintains its significance under close mowing conditions.

If this is the normal trend it would appear that for permanent sheep pastures Southland is the better seed and that for rotational grazing land (Dairy) Southland samples have an initial advantage over Sandon samples, but that at later stages the two are indistinguishable.

There is reason to believe that foreign seed when grown in New Zealand gives better results than the local product. Of the number of samples employed in this trial two were of Kentish origin and while one gave counts under weekly and 3-weekly-mowing treatments considerably higher than the average for Southland and Sandon samples the other was far and away the best plot in its counts and in addition had more vigorous and robust plants than any other plot examined. This sample was tested in duplicate in Plots 88 and 141 of Area 8 while the other Kentish sample was sown in plot 34 of the same area (See Appendix, Table 1). The better Kentish sample was dressed from perennial ryegrass seed and contained a large proportion of perennial rye and Yorkshire fog seeds of which grasses the plot contained considerable amounts. Hence the plot did not receive the amount of crested dogtail seed the other plots received and in addition suffered this extra amount of competition. This still further enhances its performance. A sample of Russian origin has given very promising indications, but was not sown in the areas used in this trial so figures of its performance are not available. No samples of Irish origin have been tested, nor have any from other parts of the world.

The New Zealand samples sown in Area 5 and for which counts over a period of thirty months are available show a very rapid fall in numbers of plants per plot with time. The first count of this series was made by Jacques (unpublished results) between the 10th. and 16th. December 1929 when the plants were about one inch above ground. These counts together with subsequent counts of the same plots and several others counted under the weekly mowing treatment are given in Table 3. The counts of 5th. March - 5th. April, 1931 were also made by Jacques. Counts of the 27th. May - 4th. June 1932 are taken from the Appendix, Table 3. These latter counts were made to indicate the rapid fall in numbers since the plot was previously counted.

TABLE 3.

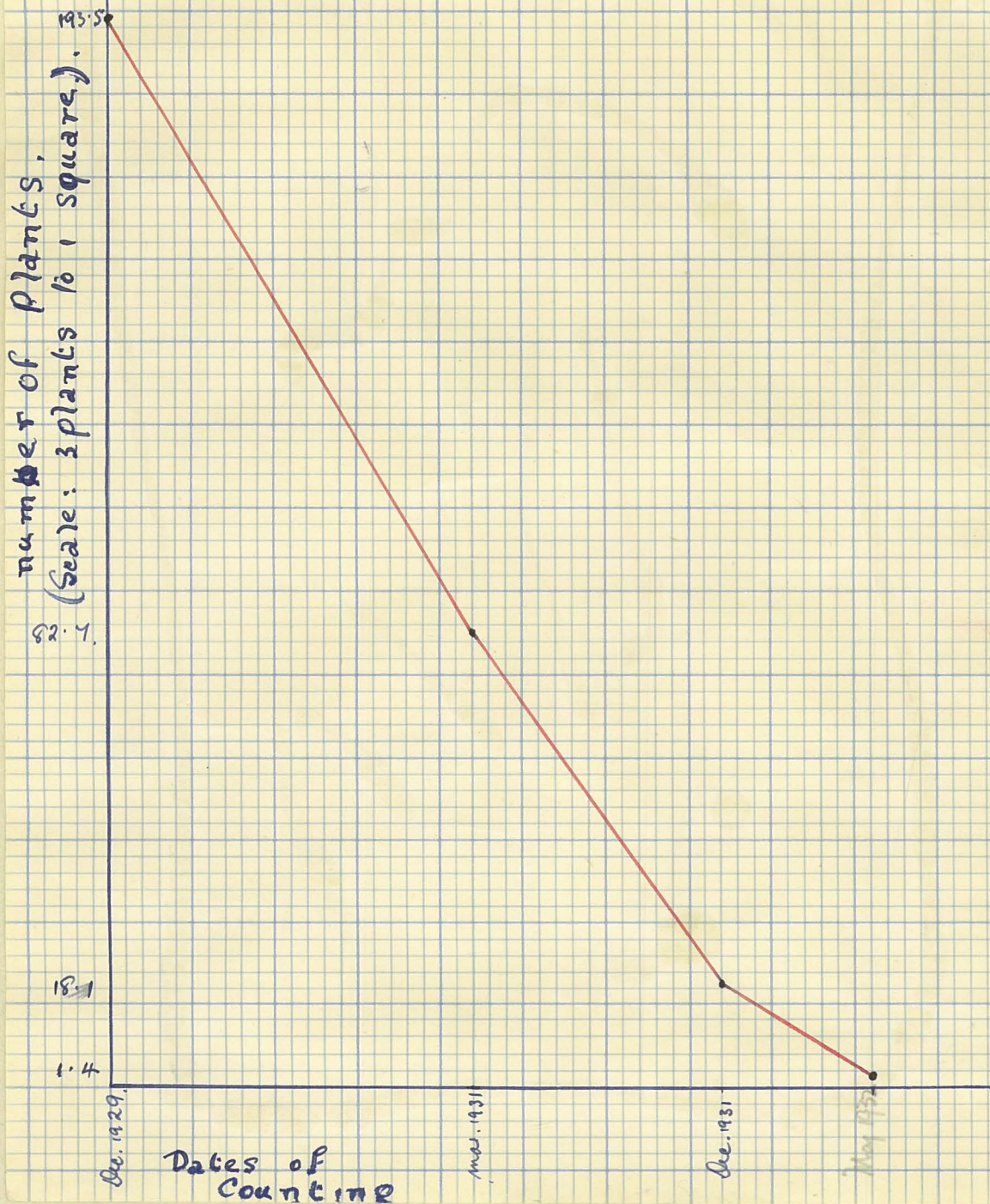
<u>Plot No.</u>	<u>Dates of Counting</u>			
	<u>Dec. 10-16</u> <u>1929</u>	<u>Mch. 5 - Apl. 5</u> <u>1931</u>	<u>Dec. 17 - Jan. 6</u> <u>1932</u>	<u>May 27 - June 4</u> <u>1932</u>
1	219	95	29	-
2	299	187	42	-
3	339	136	38	-
26	179	91	16	-
27	57	22	3	-
28	146	58	12	-
29	134	27	3	-
30	249	165	14	-
31	140	58	2	-
32	189	91	11	-
33				
34				
35	61	59	5	-
36	153	52	19	-
37	30	9	2	-
38	118	77	19	-
39	347	70	24	-
40	209	62	25	-
43	279	104	23	-
44	225	100	30	-
45	242	123	17	-
64	-	-	9	0
65	-	-	7	2
66	-	-	14	1
67	-	-	16	1
68	162	89	10	2
69	229	75	12	3
70	175	70	13	1
71	115	-	11	-
72	192	-	8	-
73	264	-	2	-
74	220	-	7	1
75	-	-	0	0
76	-	-	3	0
77	152	-	3	-
78	203	-	4	-
79	326	-	5	-
80	198	-	5	-
81	217	-	9	-
82	223	-	3	-
85	-	-	24	1
86	-	-	20	2
87	-	-	15	1
88	-	-	38	1
89	-	-	27	5
90	-	-	46	4
91	-	-	32	0
92	-	-	27	1
93	-	-	17	1
94	-	-	23	0

TABLE 3. Continued.

<u>Plot No.</u>	<u>Dates of Counting</u>			
	<u>Dec. 10-16 1929</u>	<u>Mch. 5 - Apl. 5 1931</u>	<u>Dec. 17 - Jan. 6 1932</u>	<u>May 27 - June 4 1932</u>
125	160	-	15	-
126	150	-	8	-
144	-	-	36	1
145	-	-	20	1
146	-	-	43	0
147	-	-	30	1
148	-	-	27	0
149	-	-	36	3
150	-	-	20	0
151	-	-	38	0
152	-	-	25	1
153	-	-	43	3
154	-	-	17	5
168	162	-	22	-

This table serves to show that there has been a considerable falling off in numbers, till in June 1932 very few plants remained. The trend of the average figures of table 3 as indicated in figure 2 which shows a very rapid decline from a high initial figure to a very low figure thirty months later. This graph shows the trend of the average plot counts for the different stages in development but takes no account of individual sample performance or that of seed produced in the different seed growing districts. It shows, however, that the New Zealand samples under short mowing conditions are extremely non-persistent.

Figure 2.



Some plots have maintained their numbers better than others but nevertheless there has been a rapid falling off in numbers in all the plots shown in Table 3 and this will serve to show that selection of particular samples is going to be of little use, that one will have to resort to individual selection and from a few individual plants to build up a persistent strain of crested dogstail. Before such work is undertaken, however, it would be wise to obtain samples from different parts of the world and test them along with local samples to see if any of them show greater persistency, and productivity than New Zealand samples.

DATE OF FLOWERING IN RELATION TO PERSISTENCY. .....

It was thought that if any correlation could be discovered between date of flowering and persistency of crested dog-tail samples it would be of great value to the seed trade in two ways. Firstly, if types flowering about a certain day were shown to be more persistent than others then flowering date would afford a ready means of identification of the better strains. Secondly, superior strains flowering about certain days would not suffer cross pollination by inferior plants flowering on other days and hence would remain reasonably pure.

An endeavour was made to determine as near as possible the date of early maximum flowering of each hay plot by direct observation. The date of early maximum flowering was taken to be the earliest date of December 1931 on which most of the inflorescences of the hay plots of Areas 5 and 8 showed a maximum development of anthers. It was not difficult to determine this date, for in the different plots it extended over a period of ten days. The development of anthers was observed about 10 a.m. each day after the flowers had opened. (See Appendix Table 4 for dates of maximum flowering).

No correlation could be discovered between date of maximum flowering and the counts in the weekly mown treatment in Areas 5 or 8 nor in the hay sub-plots of Area 8. This result was not to be expected in view of several of the highest counting weekly mown plots being the latest to flower and some of the lowest counting plots flowering early.

THE RELATIONSHIP BETWEEN GERMINATION OF SAMPLES  
AND THE NUMBER OF PLANTS PRESENT UNDER A WEEKLY  
MOWING SYSTEM.

The 8 and 18-day percentage germination figures of the commercial samples sown have been obtained from the Government Seed Testing Station Records. These figures (See Appendix, Table 4) have been analysed statistically to discover any correlation between them and number of plants in weekly mown plots of Areas 5 and 8. Such correlations are :-

Between Final Germination and Counts  
of Area 8,  $.201 \pm .067$  and of Area 5,  $.287 \pm .051$ ;  
and Between Interim Germination and Counts  
of Area 8,  $.181 \pm .067$  and of Area 5,  $.374 \pm .048$ .

Discussion.

These correlation figures for Area 8 are not at all marked; but for Area 5, which is older established, the correlations are higher, but not significantly different from one another and show that number of surviving plants bears a close relationship <sup>to</sup> ~~and~~ germination figures.

These figures also serve to show that better correlation exists between the counts of the older plot and the germination figures so that it appears that high germinating seed may produce relatively a greater number of more persistent plants than low germinating seed. It is hoped, at some future date, to obtain further counts from Area 8 to see if this tendency is normal.

Correlations between Jacques' counts of the plants in the weekly mown treatment of Area 5 and Final and Interim Germination percentages of  $+ .158 \pm .082$  and  $+ .268 \pm .078$  are not so high as they are a year later. When Area 8 is older established it is very probable that the correlation coefficients between

Interim and Final germination figures, on the one hand, and number of plants present under a weekly mowing system will be higher than the figures given above. If this is found to be so it will be further evidence for the hypothesis that high germinating seed produces relatively a greater number of more persistent plants than low germinating seed - that high germination percentage of seed is a better indication of permanency than low germination percentage.