THE EFFECTS OF SEED SIZE ON VARIOUS AGRONOMIC CHARACTERS OF BARLEY GROWN IN OKLAHOMA

By

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CHAPTER I

INTRODUCTION

Barley is grown in nearly all cultivated areas of both hemispheres. It is regarded by many as the most widely cultivated grain crop. Most of the barley crop grown in the United States is used for livestock feed. In some Asiatic countries, large quantities of the grain are consumed by human beings. Because barley is predominately a feed grain in the United States, it is very important to have large kernels with good feeding quality. One quality factor is measured by the ratio of endosperm to total kernel. Large kernel barley varieties have a greater amount of endosperm present as compared to total kernel.

A large amount of the barley goes into industrial uses. Barley is important in making malt, which is used principally in brewing beer. Kernel size is an important factor for determining the acceptability of barley for malting purposes. Anheuser-Busch, Inc. has specified the requirements of greater than 60 per cent large plump kernels and less than five per cent small thin kernels for barley to be accepted as malting barley (8). Rutger, Schaller, and Dickson (26) reported a significant positive correlation between barley kernel size and malting quality.

It is very important that a barley breeding program emphasize selection for quantity as well as quality. Consequently, it would be very helpful to know how agronomic characters, especially yield, are affected when selection is made for kernel size. The primary objective of this study was to determine the effects of selection for seed size on yield, individual yield components, heading date and height.

CHAPTER II

REVIEW OF LITERATURE

Yield

A large percentage of the barley grown in Oklahoma is used as livestock feed. The grower's primary concern is the yielding ability of the barley varieties grown. Woodworth (32) cited environment and heredity as the two main forces determining the amount of seed produced by crop plants. Grafius (12) expresses yield as follows:

$$W = XYZ$$

(W) = yield
(X) = number of spikes per unit area
(Y) = kernels per spike
(Z) = kernel weight

He concluded that yield is the product of number of spikes, number of kernels per spike, and kernel weight; then any gain in a single yield component offset by a decrease on one or both of the other components would produce no gain in total yield. However, an advance in one component with the others remaining constant would produce an equal advance in total yield.

Cannell and Rasmusson (6) found that barley progenies selected for high and low yield from F_4 population differed significantly for yielding ability. Their results revealed that selection for greater numbers of tillers resulted in greater yield. They also cited a significant reduction in yield by selecting for high number of kernels per spike. Gilchrist (11) reported a relatively high positive correlation of yield with kernels per spike when eighteen varieties and experimental lines of barley were studied. He stated that the entries producing a high number of kernels per spike tended to yield higher than entries with a low number of kernels per spike. His results showed kernels per spike to be the only yield component which was significantly correlated with yield. Johnson et al. (13) compared yield components and agronomic characters of four winter wheat varieties. They also noted a positive association of yield with number of kernels per spike.

Kaufmann and McFadden (17) studied the competitive interaction between barley plants grown from large and small seeds. They observed that plots planted with large seeds were more vigorous, headed earlier and consistently outyielded those planted with small seed. Beletskii and Kovalev (4) divided their barley seed into three classes: large, medium and small. Their results showed no difference in yield of plots planted to large or medium seed but those planted to small seed were significantly lower in yield. Peterson and Foster (22) and Petrov and Stefanov (23) concluded that plots planted with large seed gave the highest yield of the barley varieties under study. Osher (24) studied the effects of seed size on yield of common wheat, Durum wheat, and six rowed barley. The seed was graded into large and small sizes and planted at equal density. From the various wheat and barley varieties, they showed that larger seed gave plants with a grain yield 24 percent higher than those of entries planted to smaller seed. Kaufmann (15) concluded that plants from large seed grown close to plants from small or medium seed would have a competative advantage because of the superior root system produced by the large seed. Taylor (29) studied effects of continuous selection of small and large wheat seeds on yield and other characters. He found that plots planted with large seed outyielded those planted with small seed in five of six years. His results showed that gains in yield from using large seed in comparison to small seed varied from 0.3 percent to 18.7 percent. Kaufmann and McFadden (18) studied the influence of seed size on barley yield in Canada. They found plots planted with large and small seed were easily distinguishable shortly after emergence; plants from large seed were more vigorous. Also plots planted with large seed headed and ripened earlier. No differences in kernel weight among seed lots within varieties were reported. Their results showed that plots planted with large seed yielded significantly more than standard seeds in three of nine tests in Central Alberta. Only slight advantages were shown for large seed in Northern Alberta.

Kernel Weight

Reports from workers studying several different crops have shown seed weight to be positively correlated with yield. Demirlicakmak _et al._ (7) and Gilchrist (11) found barley yield to be more closely correlated with kernel weight or kernels per spike than with number of tillers. Ketata (19) reported similar results while studying three hard red winter wheat varieties. An experiment on soybeans by Adams (1) showed seed yield was affected only slightly by a drastic reduction in pod number. However, he stated that a reduction in pod number per plant was accompanied by increases in both number of seeds per pod and kernel weight. Olsson (21) reported a highly significant positive correlation between kernel weight and yield per plant of mustard and rape. He stated that the number of seeds per pod and kernel weight are less influenced by environment than number of pods and yield, thus they are more easily changed genotypically by selection.

Sharma (26) stated that kernel weight in wheat is controlled by a relatively small number of genes, perhaps as few as four, and is highly heritable. Fiuzat and Atkins (9) found positive correlation for yield with kernel weight of segregating barley populations. They concluded that the positive correlation for grain yield appeared to be of little value for selection because of negative correlations between kernel weight and number of tillers. Cannell and Rasmusson (6) found selection for kernel weight resulted in a positive response in number of spikes per plant, but a negative response in kernels per spike. Early maturing genotypes tended to have fewer tillers and higher kernel weight but fewer kernels per spike (10). Johnson et al. (14) and Fiuzat and Atkins (9) found plant height to be significantly correlated with kernel weight and grain yield. Waldron (31) used sister lines of hard red spring wheat in his yield trials. He found that yield increased as kernel weight increased.

Tillers

Bonnett and Woodworth (5) stated that the number of tillers influences yield by affecting the number of kernels per spike and kernel weight. They found, with the same variety, plots planted with large seed produced a greater number of tillers than those planted with small seed. Their analysis showed that if plots were planted at the same rate, a variety having small seed may outyield a larger seed variety. They concluded this was due to the larger number of plants per unit area of plots planted with small seed rather than superior plant yield. Kiesselbach (20) found when large and small seeds of small grains were planted in equal numbers, the small seeds yielded eleven percent less than the large seed. When equal weights of seed were planted, small seed yielded three percent less than the large seed. He concluded that the yield increase was due largely to the greater number of the small seeds planted. Kaufmann and Guitard (16) studied effects of seed size on early plant development of two barley varieties. They found that plots planted with large seed gave the greatest number of tillers for both varieties. Demirlicakmak et al. (7) looked at influences of seed size and planting rate on yield of barley. They concluded that tillering capacity taken alone was not a good indicator of yield. Johnson et al. (14) stated that selection for a greater number of tillers and higher yield would be ineffective in hard red winter wheat. They based these conclusions on the low heritability percentages obtained for these characters.

CHAPTER III

MATERIALS AND METHODS

Population and Seed Size

This study consisted of three populations of barley lines each having three seed sizes. Lines within each population were selected for their ability to produce seed of a given size. All were experimental lines having winter type growth habits. Population one and two contained six lines from the cross 2*Rogers/Kearney. These lines were selected from F_6 bulk hybrids. Population three consisted of three lines from the cross Tenkow/Rogers. This material was selected in the F_5 generation.

Seed size classes were separated by running the samples through a clipper seed cleaner containing 6/64" x 3/4" and 7/64" x 3/4" slotted screens. Seeds remaining on the 7/64" screen were classed as large and kernels passing through the 6/64" screen were classed as small. The unselected class was a random sample of kernels that were not screened.

Field Layout

The experimental design was a randomized complete block with four blocks per location and two locations for each of the two years. Each block contained nine plots. The plots were three meters long and consisted of four rows spaced thirty centimeters apart.

The plots were seeded at the rate of 260 and 290 kernels per row in year one and two, respectively. These rates are equivalent to ten grams per row and forty grams per plot or 108 kg/ha of large kernels. The following formula was used to determine the proper seeding rate:

$$R = \frac{(W)(N)}{100}$$

(R) = grams per row
(W) = weight per 100 kernels
(N) = number of kernels desired per row

The Stillwater test (location one) and Altus test (location two) were planted during the first two weeks of October of each year. The seeds were planted in 1969 (year one) and 1970 (year two).

The field at location one was located on the Agronomy Research Station at Stillwater, Oklahoma. The soil was a Kirkland silt loam which is an upland unit on plane or weakly concave slopes averaging about one percent slope. This soil has a grayish-brown silt loam surface six to ten inches deep over a dark grayish-brown, blocky, compact clay. The subsoil is very slowly permeable. The field at location two was located on the Agronomy Research Station at Altus, Oklahoma. The Tillman-Hollister soil is comprised of deep, clay soils that have a grayish-brown, granular, clay loam surface soil. The subsoil is very dark gray to gray clay and has a blocky structure below 16 inches. The lower part of the subsoil is slowly permeable.

Characters Investigated

The following plant and seed characters were observed on all plots except where noted.

The heading date was recorded as the number of days from April 1 to the date when approximately 75 percent of the heads had emerged from the boot. This character was recorded on plots at both locations in year two only. Plant heights were determined by measuring the average distance in centimeters from the soil surface to the spike tips of the plants. Height was observed at both locations in year two only. Yield was determined as the weight, in grams, of grain produced from 2.4m rows. These rows were prepared prior to harvest by removing 0.3m from each end of the center two rows of each plot. The harvested area per plot was 1.44m^2. The yield per plot was converted to kilograms per hectare (kg/ha). Tillers/meter^2 were determined as the number of seed bearing tillers in a random 60 cm section of each plot. Kernel weight was determined by weighing, in grams, 200 kernels, chosen at random from the grain yield sample of each plot.

The number of kernels per spike was computed using the following formula:

$$N = \frac{Y}{(K)(S)}$$

(N) = number of kernels per spike
(Y) = grain yield in grams per square meter
(K) = weight in grams per kernel
(S) = number of spikes per square meter

Statistical Analyses

Statistical analyses were conducted on all characters observed using one observation per plot. A separate analysis of variance was calculated for each character for each location and each year. A combined analysis of variance over all years and locations was then calculated for each character. The effects of seed size, populations, locations, years, their interactions were obtained on each character. Least Significant Difference (LSD) as described by Snedecor (27) was used for making comparisons.

CHAPTER IV

RESULTS AND DISCUSSION

The 1969 and 1970 growing seasons at both locations were characterized by below normal moisture during development of the barley (2,3). Hail damage occurred at location one, year one and location two, year two just prior to harvest. No winter killing was observed at either location or in either year.

Yield

Location one had an average plot yield of 3518 kg/ha and location two averaged 2420 kg/ha (Table I). The 1098 kg/ha difference in yield of the two locations was highly significant. The difference in yield between the two years was also highly significant (Table II). There was also a significant location x year interaction. This indicated that the lines tended to respond differently with respect to yield to the environments of the two locations and years.

Differences in yield among populations for all locations and years combined were highly significant (Table II). Location x population, year x population and location x year x population interactions were all highly significant. This indicated that populations responded differently in both years at both locations. Analyses for each location and each year showed a significant difference in population yield only at location two, year one (Table III). Population three (Tenkow/Rogers) was signifi-

TABLE I

MEANS FOR CHARACTERS UNDER STUDY

Source	Yield kg/ha	Kernel Wt. gm/1000 k.	Kernels/ Spike	Tillers/ M^2	Height* (cm)	Heading* Date
Seed Size						
Small	3023	24.5	32.2	403	91.6	27
Unsel.	2996	26.3	30.1	414	91.5	28
Large	2887	26.7	31.1	413	89.0	27
Population						
1	3037	24.4	32.1	421	92.0	29
2	3061	25.0	31.6	420	91.8	28
3	2808	28.2	29.8	390	89.0	25
Location						
1	3518	24.2	33.4	449	92.9	27
2	2420	27.5	28.9	371	89.0	27
Year						
1	3398	29.7	33.9	399	—	—
2	2540	22.0	28.4	421	90.9	27
Loc 1 Yr 1	3559	25.1	38.7	348	—	—
Loc 1 Yr 2	3476	23.3	28.2	550	92.9	27
Loc 2 Yr 1	3237	34.2	29.0	449	—	—
Loc 2 Yr 2	1603	20.7	28.7	293	89.0	27
Overall Means	2969	25.8	31.2	410	90.0	27

*Observed only in Year Two.

TABLE II

MEAN SQUARES FROM THE ANALYSIS OF VARIANCE FOR ALL LOCATIONS AND YEARS

Source	d.f.	Yield	Kernel Weight	Kernels/ Spike	Tillers
Total	143				
Location (L)	1	43368234**	3705**	7539**	219657*
Year (Y)	1	26519088**	21006**	10557**	17982
LY	1	21641278*	12250**	9542**	1155713**
Error A					
Rep in (LY)	12	253395	104	393	5622
Population (P)	2	937970**	2016**	668	15080
LP	2	1097983**	62	770	23174
YP	2	895530**	274*	1302	2296
LYP	2	853397**	11	2362*	5985
Error B					
RP (LY)	24	124380	76	438	11531
Seed Size (S)	2	247129	624**	523	1732
LS	2	184479	526**	619	4237
YS	2	313730	88	1365	7109
LYS	2	455493	122	59	9457
Error C					
RS (LY)	24	112103	92	479	10149
PS	4	236297	40	192	17818
LPS	4	118572	57	548	2197
YPS	4	167301	40	575	2622
LYPS	4	314271	127	523	6706
Error D					
RPS (LY)	48	168776	83	432	7196

*Significant at the .05 level of probability.

**Significant at the .01 level of probability.

TABLE III

MEAN SQUARES FROM THE ANALYSIS OF VARIANCE FOR LOCATION TWO AND YEAR ONE

Source	d.f.	Yield	Kernel Weight	Kernels/ Spike	Tillers
Total	35				
Reps	3	291914	79	246	122
Population (P)	2	3474301**	820**	118	846
Seed Size (S)	2	886642	80	545	426
PS	4	427413	13	140	313
Error	24	262141	46	363	566

*Significant at the .05 level of probability.

**Significant at the .01 level of probability.

cantly lower in yield than populations one and two (Figure 1). Small, unselected, and large seeded lines yielded 3023, 2996, and 2887 kg/ha respectively (Table I). The effect of seed size on yield was not significantly different. These results do not agree with the research of references 15, 17, 18, and 22.

Kernel Weight

The overall plot average kernel weight was 25.8g (Table I). A significant difference between kernel weights of location one of 24.4g and the location two of 27.5g (Table I) was indicated in the combined location analysis of variance (Table II). Kernel weight was also significantly lower in year two than year one. The lines responded differently at each location and in each year as was indicated by the highly significant location x year interaction (Table II).

Populations were highly significantly different for kernel weight (Table II). The year x population interaction was significant indicating a different response of populations in years one and two. Populations were highly significantly different with regard to kernel weight at location one, year one (Table IV). Population three with an average kernel weight of 27.7 was significantly greater than populations one and two at location one, year one (Figure 2). There were no significant differences between populations one and two. Kernel weights of populations were significantly different at location two, year one (Table III). Population three (Tenkow/Rogers) produced an average kernel weight of 37.2g at location two, year one which was significantly higher than the other populations (Figure 3) but no differences were found between populations one and two. The populations were significantly different from each

TABLE IV

MEAN SQUARES FROM THE ANALYSIS OF VARIANCE
FOR LOCATION ONE AND YEAR ONE

Source	d.f.	Yield	Kernel Weight	Kernels/ Spike	Tillers
Total	35				
Reps	3	323478	230*	112	10379
Populations (P)	2	9830	580**	3942**	4122
Seed Size (S)	2	11337	201	1316	972
PS	4	129348	28	477	1264
Error	24	123661	61	700	4667

*Significant at the .05 level of probability.

**Significant at the .01 level of probability.

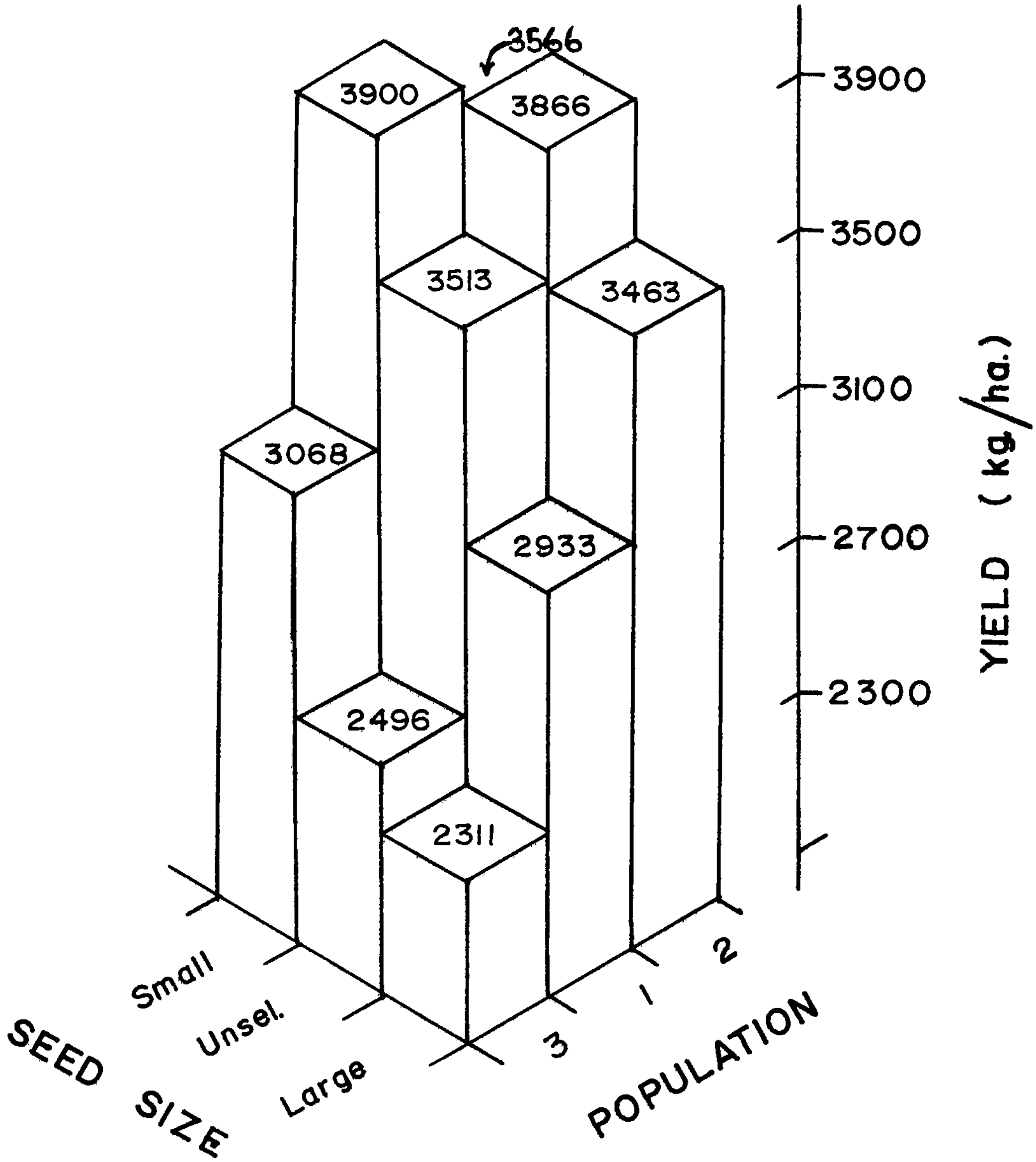

Figure 1. Location 2 Year 1: Effects of Population and Seed Size on Yield. LSD (.05) = 747 for comparing any two means in the figure

Means:

Seed Size		Population	
Small	3567	1	3449
Unsel.	3393	2	3637
Large	3468	3	2625
LSD (.05)	431	LSD (.05)	431

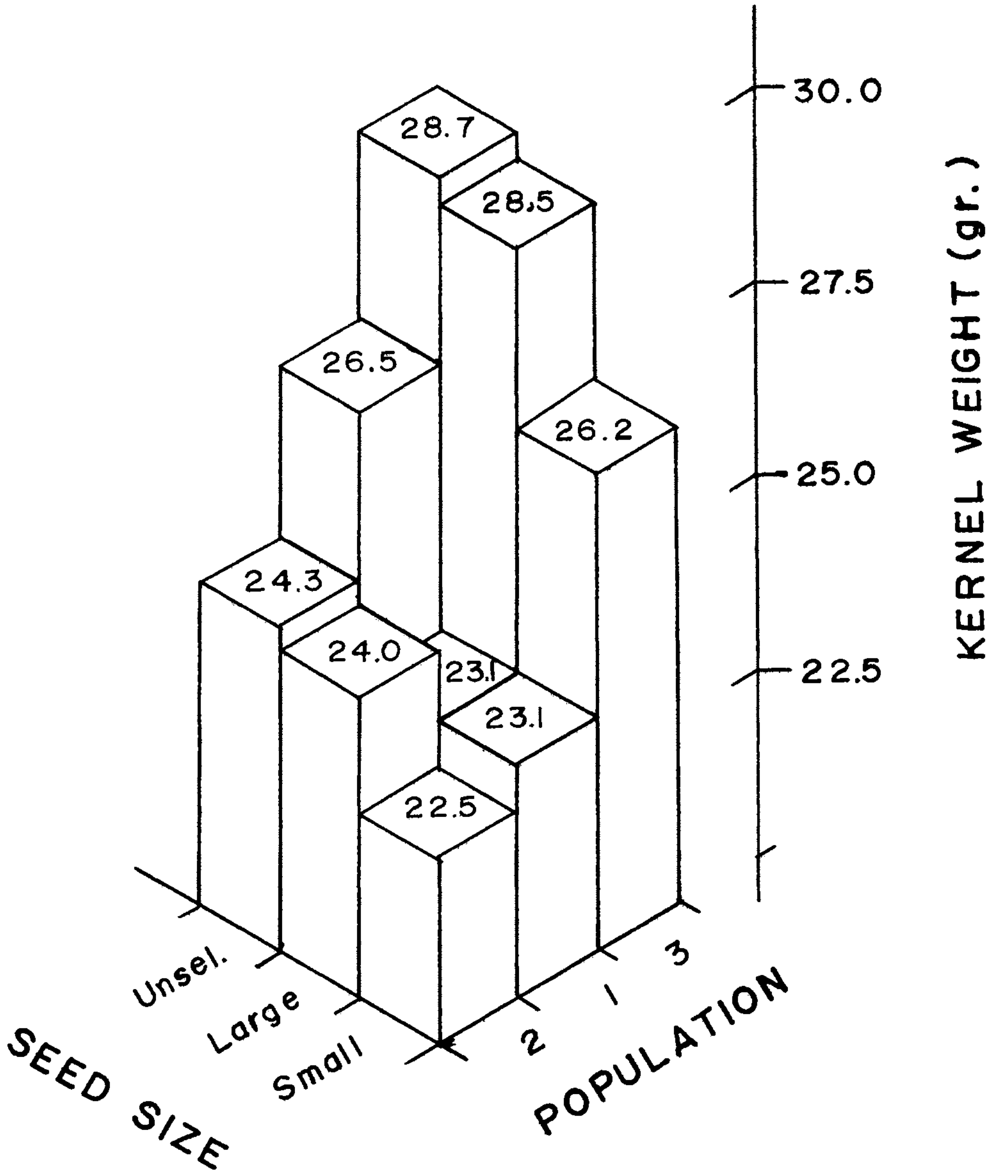

Figure 2. Location 1 Year 1: Effects of Population and Seed Size on Kernel Weight. LSD (.05) = 3.6 for comparing any two means in the figure

Means:

Seed Size		Population	
Small	23.9	1	24.2
Unsel.	26.5	2	23.6
Large	25.0	3	27.7
LSD (.05)	2.1	LSD (.05)	2.1

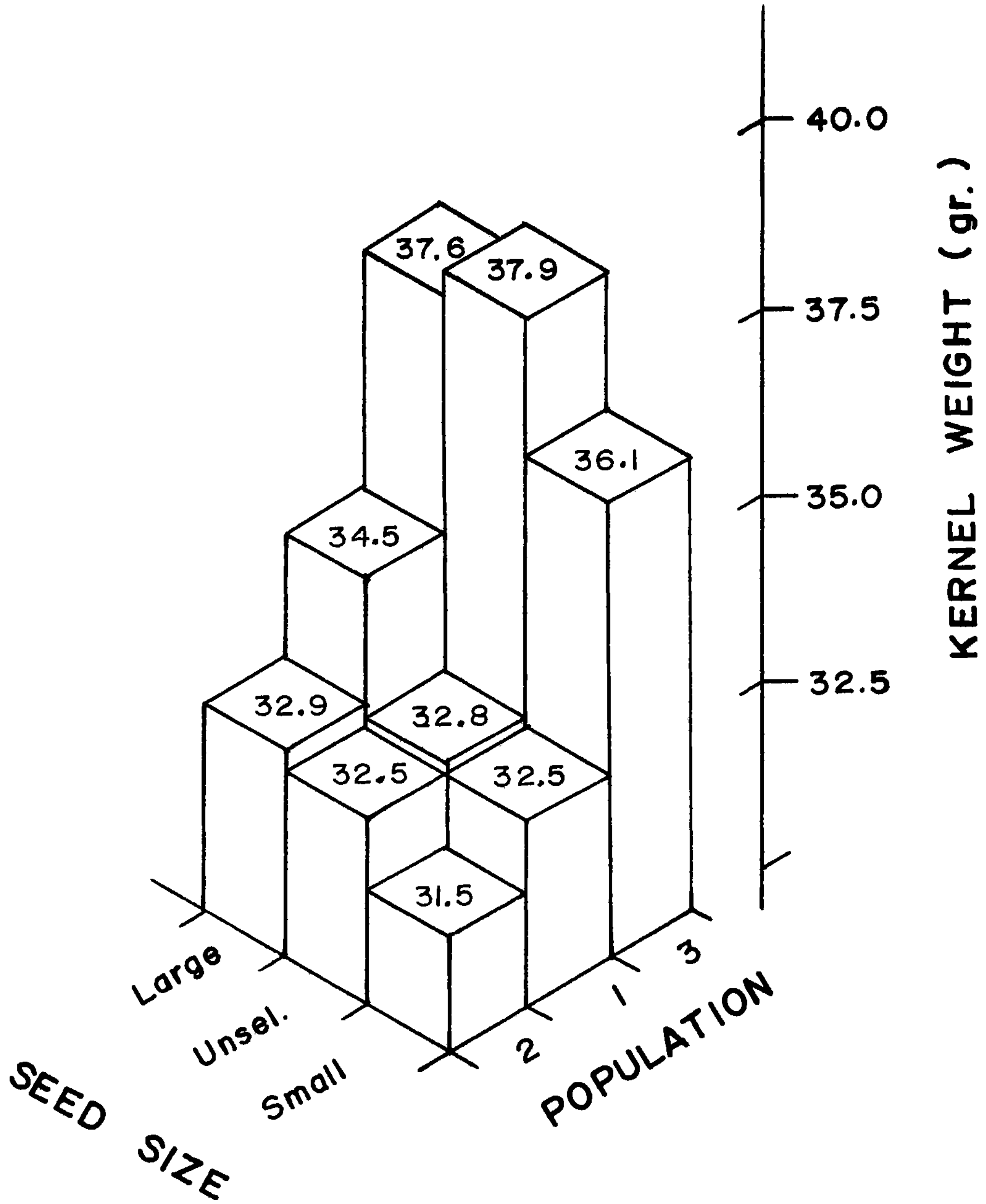

Figure 3. Location 2 Year 1: Effects of Population and Seed Size on Kernel Weight. LSD (.05) = 3.1 for comparing any two means in the figure

Means:

Seed Size		Population	
Small	33.3	1	33.2
Unsel.	34.3	2	32.2
Large	35.0	3	37.2
LSD (.05)	1.8	LSD (.05)	1.8

other with regard to kernel weight at location one and two, year two (Tables V and VI). At location one, year two, population three had an average kernel weight of 24.7g (Figure 4). Population three had a significantly greater kernel weight than population one; no other differences were found. The kernel weight of lines planted with unselected seeds were significantly greater than those planted with small seeds. At location two, year two, population three (Tenkow/Rogers) was significantly greater than population two when small seeds were planted (Figure 5). No differences in kernel weight occurred between populations when large seeds were planted (Figure 5). When unselected seeds were planted population one had a significantly lower kernel weight than two or three.

Differences in kernel weight due to seed size in the combined analysis of variance were highly significant as were the location x seed size interactions (Table II). These differences indicate differential responses of the barley lines to environment. Differences in seed size, with regard to kernel weight, were significant at both locations in year two (Tables V and VI). Kernel weights for small, large, and unselected seed sizes were 21.6, 23.2, and 25.2g respectively, at location one, year two (Figure 4). The kernel weights of lines planted with unselected seeds were significantly greater than those of the small seed size. Kernel weight of the unselected seed size were significantly greater than those of large or small seed sizes at location two, year two (Figure 5).

Kernels Per Spike

Mean squares for all data combined showed kernels/spike to be highly significant for locations, years, and location x year and significant

TABLE V

MEAN SQUARES FROM THE ANALYSIS OF VARIANCE FOR LOCATION ONE AND YEAR TWO

Source	d.f.	Yield	Kernel Weight	Kernels/ Spike	Tillers	Height	Heading Date
Total	35						
Reps	3	37417	61	572	235	7**	1
Population (P)	2	117923	296*	802	208	1	296**
Seed Size (S)	2	91658	386*	317	74	4*	13
PS	4	111859	37	210	346	16**	18*
Error	24	69717	70	238	198	1	4

*Significant at the .05 level of probability.

**Significant at the .01 level of probability.

TABLE VI

MEAN SQUARES FROM THE ANALYSIS OF VARIANCE FOR LOCATION TWO AND YEAR TWO

Source	d.f.	Yield	Kernel Weight	Kernels/ Spike	Tillers	Height	Heading Date
Total	35						
Reps	3	360771*	47	639	59	10	5*
Population (P)	2	182825	666*	240	408	129**	1
Seed Size (S)	2	211193	694*	389	243	61**	0.194
PS	4	167822	186	1012	310	11	0.403
Error	24	118517	157	479	319	9	1

*Significant at the .05 level of probability.

**Significant at the .01 level of probability.

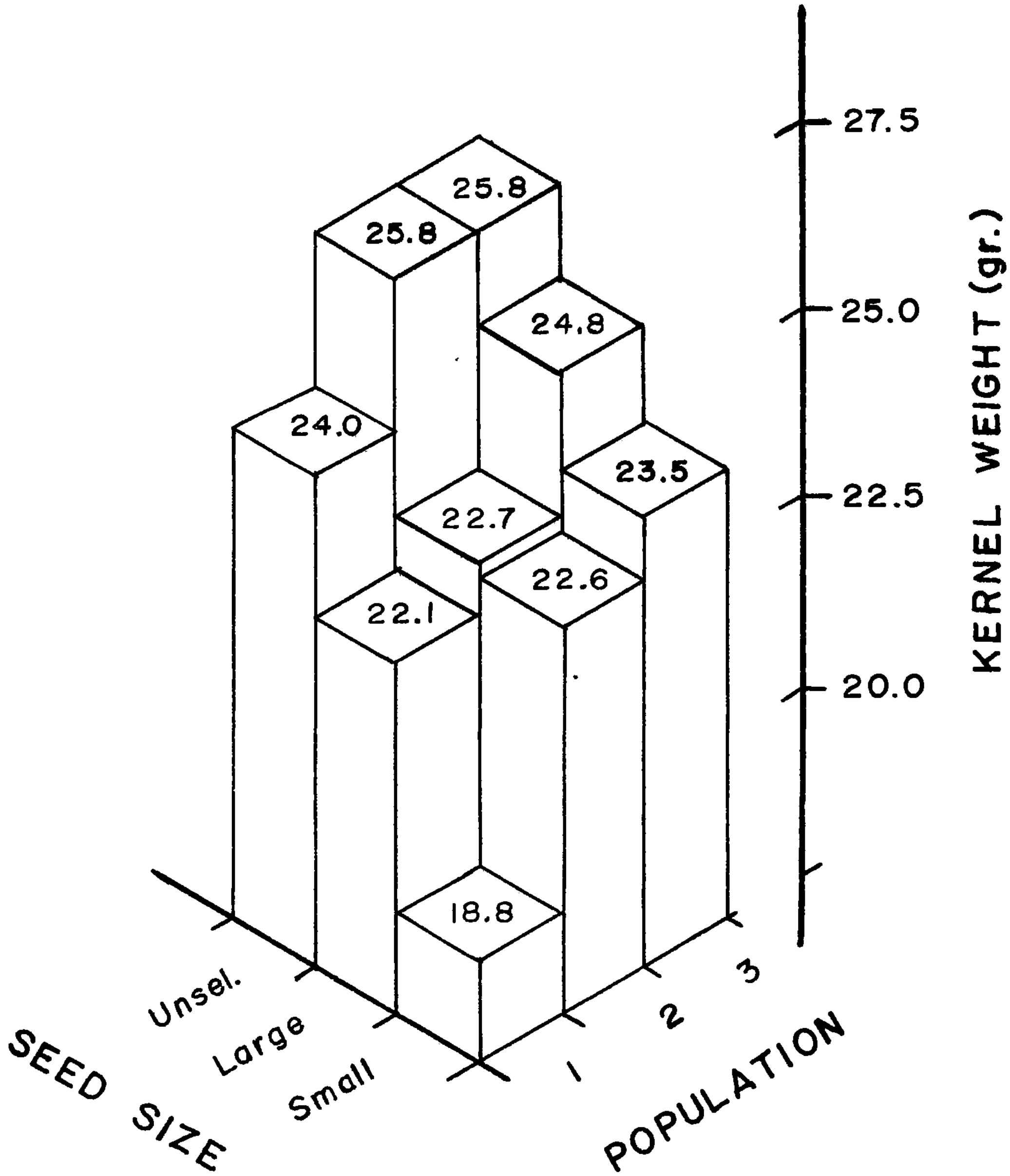

Figure 4. Location 1 Year 2: Effects of Population and Seed Size on Kernel Weight. LSD (.05) = 3.8 for comparing any two means in the figure

Means:

Seed Size		Population	
Small	21.6	1	21.6
Unsel.	25.2	2	23.7
Large	23.2	3	24.7
LSD (.05)	2.2	LSD (.05)	2.2

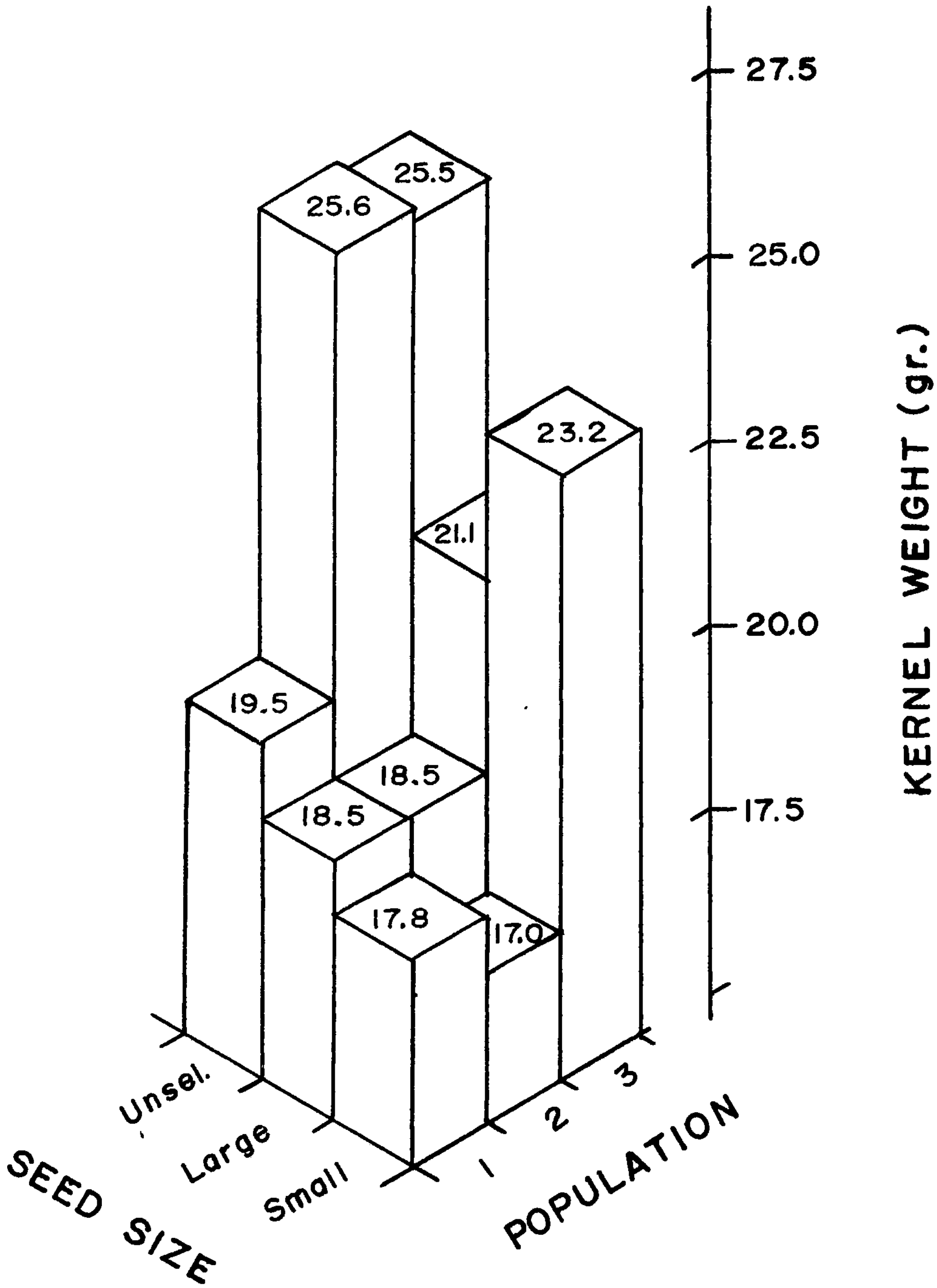

Figure 5. Location 2 Year 2: Effects of Population and Seed Size on Kernel Weight. LSD (.05) = 5.7 for comparing any two means in the figure

Means:

Seed Size		Population	
Small	19.3	1	18.6
Unsel.	23.5	2	20.3
Large	19.3	3	23.2
LSD (.05)	3.3	LSD (.05)	3.3

for location x year x population interaction (Table II). Location one had a plot average of 33.4 kernels/spike compared to 28.9 kernels/spike at location two (Table I). This difference of 4.5 kernels/spike is highly significant. The test conducted in year one averaged 33.9 kernels/spike compared to 28.4 in year two. This 5.5 kernels/spike difference is also highly significant. At location one, year one, the populations were significantly different for kernel/spike (Table IV). Population three (Tenkow/Rogers) was significantly lower in kernels/spike than populations one and two (Figure 6). Seed sizes of small, large and unselected produced 32.2, 31.1, 30.1 kernels/spike respectively (Table I). No significant difference in kernels/spike from the various seed sizes was observed (Table II).

Tillers

Location one had a plot average of 449 tillers/m^2 compared to 371 tillers/m^2 at location two which was significant (Tables I and II). Plots averaged 399 tillers/m^2 in year one compared to 421 tillers/m^2 in year two. No significant difference in years for tillers was found. However, the populations responded differently at a given year and location as evidenced by the highly significant location x year interactions (Table II). Populations one, two, and three averaged 421, 420, and 390 tillers/m^2 respectively. The small, unselected, and large seed sizes produced 403, 414 and 413 tillers/m^2 respectively. No significant differences in tillers/m^2 from the seed sizes were observed.

Plant Height

Plant heights were observed at location one and two in year two.

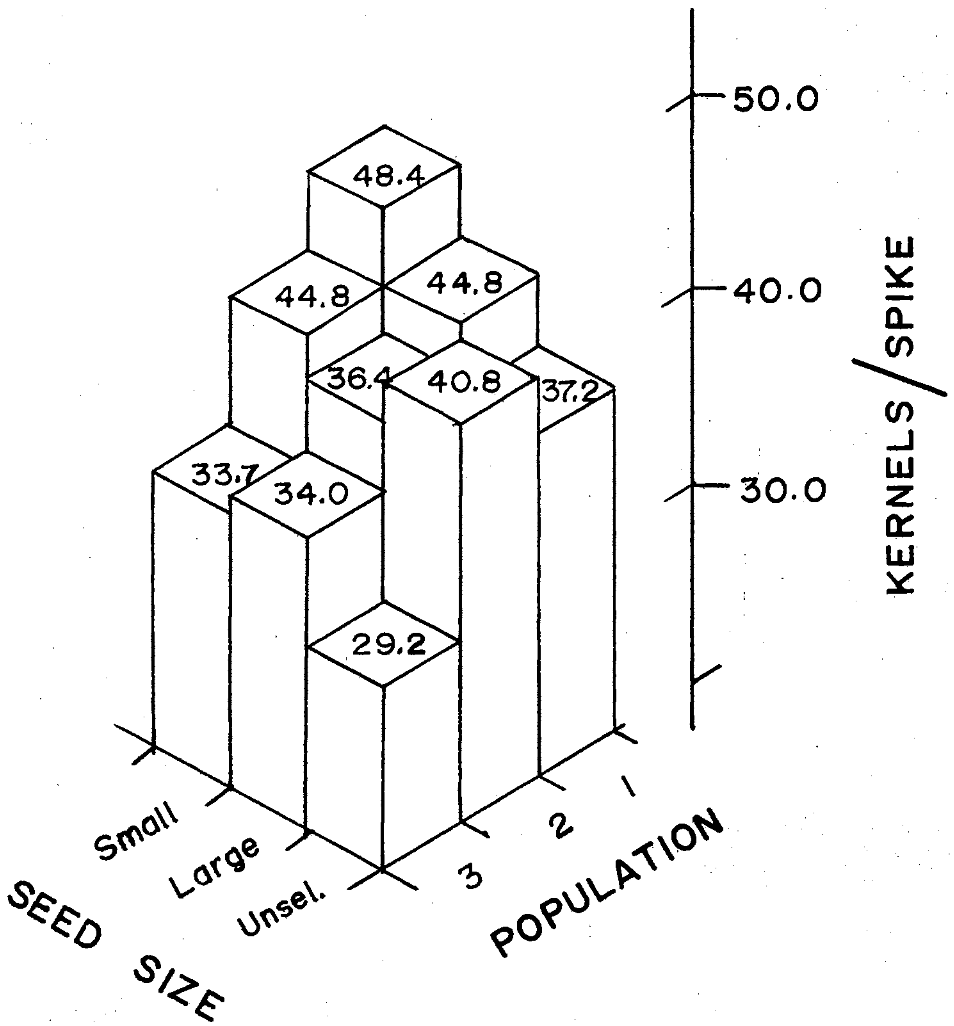

Figure 6. Location 1 Year 1: Effects of Population and Seed Size on Kernel/Spike. LSD (.05) = 12.2 for comparing any two means in the figure

Means:

Seed Size		Population	
Small	42.3	1	43.2
Unsel.	35.7	2	40.7
Large	38.2	3	32.3
LSD (.05)	7.1	LSD (.05)	7.1

Plots at location one averaged 92.9 cm compared with 89.0 cm at location two (Table I). These differences due to locations were highly significant (Table VII). The differences in height due to populations were highly significant. Location x population interaction was also highly significant. This difference in height due to location x population interaction indicates that the populations showed a differential response to the two locations. Height differences in the populations were significant at location two, year two (Table VI). Population three had an average height of 85.3 cm which was significantly shorter than population one and two (Figure 7).

The effects on height due to seed size were significant (Table VI). The location x seed size and location x population x seed size interactions were highly significant. The location x seed size interactions are best illustrated by the large seed size which was associated with a decrease in height from 92.9 cm at location one to 86.5 cm at location two. The three way interaction was illustrated by the small seed size of population one. Heights increased from 89 cm at location one to 94 cm at location two; whereas, small seed of population three was 93 cm and 85 cm at locations one and two respectively (Figures 7 and 8).

At both locations in year two, seed size had significant effects on height (Tables V and VI). The height of 92.3 cm for small seed size at location one, was significantly shorter than the unselected seed. There was no difference in height of large and small seed size (Figure 8). Heights at location two of 91.0, 89.5 and 86.5 cm for small, unselected and large seeds were produced. The heights of large seeds were significantly shorter than small or unselected (Figure 7).

TABLE VII

MEAN SQUARE FROM THE ANALYSIS OF VARIANCE FOR BOTH LOCATIONS IN YEAR TWO

Source	d.f.	Heading Date	Height (cm)
Total	71		
Location (L)	1	3.125	271.057**
Error A RL	6	3.495	0.052
Population (P)	2	127.931**	70.520**
LP	2	170.292**	60.305**
Seed Size (S)	2	7.930	27.509*
LS	4	5.292	38.799**
PS	4	7.556*	6.676
LPS	4	11.083*	21.192**
Error B RPS (L)	48	2.890	5.620

*Significant at the .05 level of probability.

**Significant at the .01 level of probability.

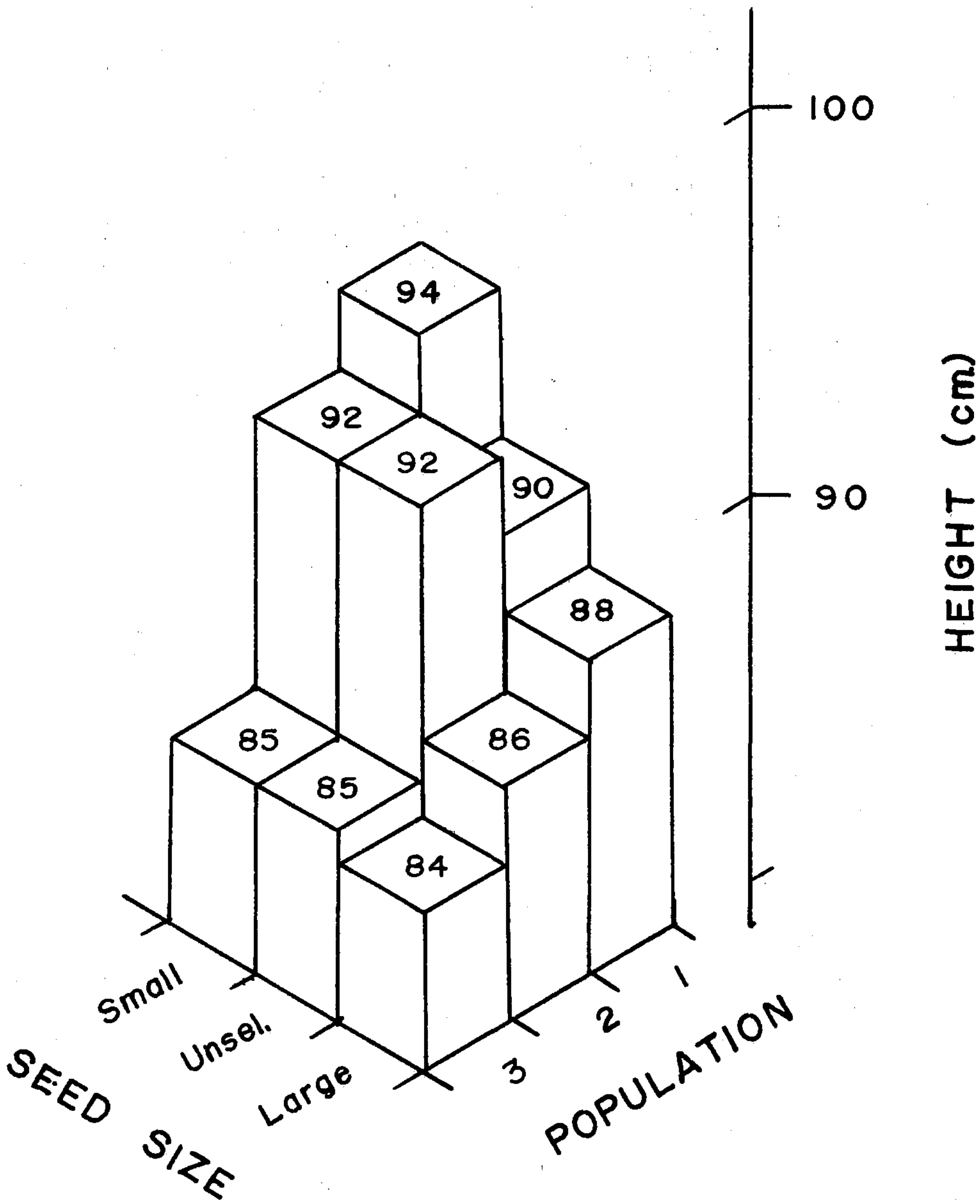

Figure 7. Location 2 Year 2: Effects of Population and Size on Height. LSD (.05) = 4.5 for comparing any two means in the figure

Means:	Seed Size		Population	
	Small	91.0	1	91.4
	Unsel.	89.5	2	90.3
	Large	86.5	3	85.3
	LSD (.05)	2.6	LSD (.05)	2.6

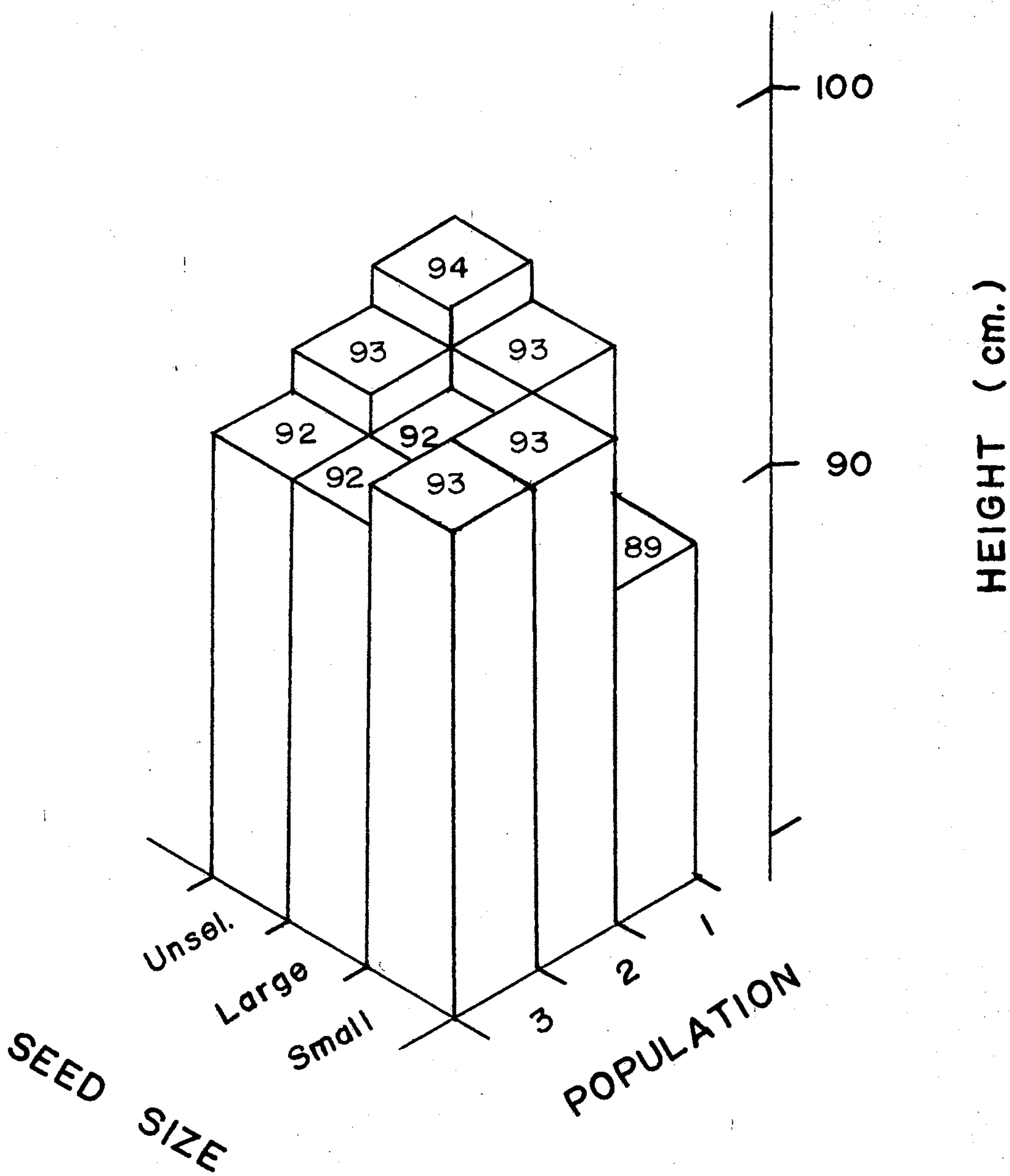

Figure 8. Location 1 Year 2: Effects of Population and Seed Size on Height. LSD (.05) = 1.7 for comparing any two means in the figure

Means:

Seed Size		Population	
Small	92.2	1	92.7
Unsel.	93.5	2	93.3
Large	92.9	3	92.7
LSD (.05)	0.9	LSD (.05)	0.9

Heading Date

Heading date was observed at location one and two in year two only. The locations were not significantly different for heading date (Table VII). However, the populations were highly significant for heading date. The location x population interaction was also highly significant. This interaction was best illustrated by comparing the heading dates of populations one and three. Heading date of population one dropped from 31 days at location one to 27 days at location two; whereas, population three at location one increased from 22 days to 27 days at location two. At location one population one, two and three had average heading dates of 31, 30, and 22 days respectively. The populations were highly significant in regard to their differences in heading date (Table V). Population three (Tenkow/Rogers) headed eight days earlier on the average than population one and nine days earlier than population two (Figure 9). At location one the unselected seed size populations headed two days earlier than the large or small. This difference in heading was statistically significant (Table V).

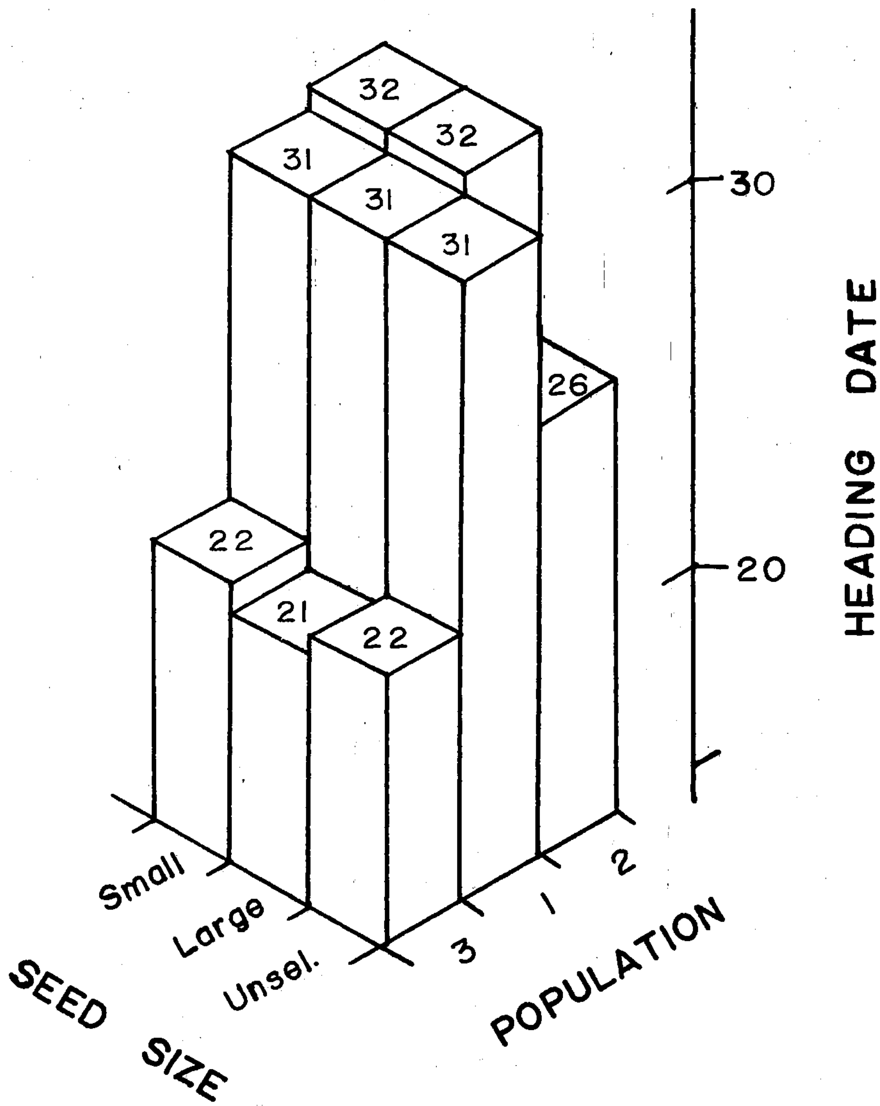

Figure 9. Location 1 Year 2: Effects of Population and Seed Size on Heading Date. LSD (.05) = 3.0 for comparing any two means in the figure

Means:

Seed Size		Population	
Small	28	1	31
Unsel.	26	2	30
Large	28	3	22
LSD (.05)	1.8	LSD (.05)	1.8

CHAPTER V

SUMMARY AND CONCLUSIONS

The primary objective of this study was to determine the effect of selection for seed size on grain yield, three yield components, heading date, and height.

Agronomic characteristics were evaluated for each of three populations planted from three seed sizes grown in replicated nursery plots at two locations for two years. Characters analyzed were: yield, kernel weight, kernels/spike, tillers/m^2, plant height and heading date. The latter two were observed at both locations in one year only. Analyses of variance were calculated from the data of each location in each year individually and the combined data of the two locations and two years. Significant means were compared by using the Least Significant Difference (LSD) at the .05 level of probability.

Significant differences between locations existed for all characters except heading date. Significant difference between years existed for all characters except tillers/m^2. Yield, kernel weight, kernels/spike, and tillers/m^2 had significant location x year interactions. Analyses of variance indicated that significant differences among populations were present at both locations and years for yield and kernel weight. Significant differences among populations were observed at both locations in year two for heading date and height. Location x population interactions were significant for yield, heading date, and height. Yield and kernel weight were the only characters showing a significant year x population interaction. Location x year x population interactions were significant for yield and kernels/spike.

The analysis of variance indicated that significant differences due to seed sizes were present for both locations and years for kernel weight only. Location x seed size interactions were significant for kernel weight and height at the .01 level of confidence. Location x population x seed size interactions were significant for heading date and height.

Selection for seed size had the following effects on the six characters studied:

(1) There was no significant effect on yield.

(2) Kernel weights were significantly affected; the small seed had a kernel weight 4.0g less than the large or unselected seeds.

(3) There was no significant effect on the number of kernels/spike.

(4) Tillers/m^2 were not significantly affected by selection; small seed size produced ten tillers/m^2 less than the large or unselected.

(5) Heights were significantly affected by selection; large seed size had heights less than the unselected seed size.

(6) Heading dates were affected by selection; unselected seed size was significantly less than large or small seed at location one.

This study indicates that selection for seed size alone will not increase grain yield sufficiently to warrant its use. Seed sizes were not good indicators of yield for the three populations used in this study.

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