GROWTH AND YIELD OF POTATO (*SOLANUM TUBEROSUM* L.) CULTIVARS ATLANTIC AND MONONA AS INFLUENCED BY SEED TYPE AND SIZE[1]

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Abstract

Growth and yield of potato plants grown from several weight classes of whole "B" seed, unsorted "B" seed, and 56 g cut seed pieces were compared in Ohio in 1988 and 1989. Whole "B" seed classes were 8 g ranges with means of 35 g, 43 g, 51 g, and 58 g. Unsorted "B" seed was used as an experimental control. Treatment responses were inconsistent. Few significant differences were evident at bloom in leaf area, number of main stems, and total plant dry weight (without tubers) per hill. However, the number of tubers greater than 1 cm in diameter per hill at bloom was less for cut seed as compared with several whole seed treatments. Percent stand at four weeks was also less for cut seed compared with 51 g and 58 g whole tuber treatments. Significant differences in total and U.S. No. 1 yields were absent despite differences in several plant growth variables early in the 1988 and 1989 growing seasons.

Compendio

Se comparó el crecimiento y el ren dimiento de plantas de papa procedentes de semilla entera "B" de variados pesos, semilla "B" no clasificada, y porciones de 56 g de semilla cortada en Ohio, en 1988 y 1989. Las semillas "B" enteras tuvieron 8 g de diferencia con promedios de 35 g, 43 g, 51 g y 58 g. La semilla "B" no clasificada por peso fue utilizada como control experimental. Las respuestas de los tratamientos fueron inconsistentes. Algunas diferencias sisgnificativas fueron evidentes al momento de la floración, en área de hoja, número de tallos principales y peso seco total de planta (sin tubérculos) por mata. Sin embargo, el número de tubérculos de más de 1 cm de diámetro por mata, el momento de la floración, fue menor para los tubérculos cortados en comparación con varios tratamientos de semilla entera. El porcentaje de plantas establecidas a las cuatro

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semanas también fue menor para la semilla cortada en comparación con los tratamientos con tubérculos enteros de 51 g y 58 g. No se encontraron diferencias significativas en los rendimientos totales y de U.S. No. 1 a pesar de las diferencias entre diversas variables del crecimiento de las plantas en las temporadas de cultivo de 1988 y de 1989.

Introduction

Research and commercial production history have shown that potato seed piece or tuber weight may influence plant development and yield (6, 16, 24, 30, 32, 33). For example, data summarized by Iritani and Thornton (1985) showed an apparent curvilinear relationship between seed weight and total yield for cv. Russet Burbank. Nelson and Thoreson (1982) obtained higher total yield in cv. Norgold Russet by using heavier seed pieces cut from smaller mother tubers. Wurr (1974) also reported higher total yield with higher whole seed weight from 25g-100g in Cambridge, England plots.

Other reports have shown that the type of seed planted may effect stand establishment, plant development and yield (17, 18, 28). However, neither seed type was found to be clearly superior in studies comparing whole and cut seed in Canada (17, 18, 22). The use of whole or cut seed to maximize yield potential may depend on the cultivar and production environment. Small (approx. 40 g) whole tubers are planted in Europe while cut seed pieces are used in North America. The cutting operation requires additional expenses for machinery and labor, increases the potential for spread of tuberborne diseases, and produces blind seed pieces. Managing the cutting operation with sufficient precision to maximize yield potential is also difficult (12, 30).

Planting whole seed may simplify pre-plant handling of seed and reduce problems specifically associated with cut seed. More extensive use of whole seed is being explored in seed-potato producing areas of the U.S., partly in response to increased emphasis on improved disease control (7, 22, 23). McKeown (1990a) recommended investigating the use of whole seed to improve stand establishment. However, cultivar-environment interactions and differences in market requirements complicate seed management decisions. Additional data comparing whole and cut seed may aid in these decisions for other potato producing areas.

Relationships among cut seed piece weight, plant growth, and yield have been described for cultivars of major commercial importance in parts of the U.S. and Canada. Similar studies have been conducted on whole seed in Europe. In this experiment, we investigated relationships of seed type and weight to plant growth and yield under central Ohio conditions. This experiment intended to: 1) compare stand establishment, plant development, and yield of cvs. Atlantic and Monona grown from whole ("B") and cut seed, and 2) establish the influence of whole seed tuber weight on the same variables.

Materials and Methods

During 1988 and 1989, factorial sets of treatments of two planting dates, two cultivars, and six seed classes were evaluated in a randomized complete block design containing five replications per planting. Soil type was a Wooster silt-loam (fine-loamy, mixed, mesic Type Fragiudalf) with a pH of 6.0 and organic matter of 3%. Fertilizer (N:P:K 10-20-20) was applied at 672 kg/ha plow down and 672 kg/ha banded at planting. Cultivation, hilling, and hand weeding were conducted as necessary.

Herbicides used included metolachlor (1.9 kg a.i./ha) + metribuzin (1.5 kg a.i./ha). Insecticides used primarily for control of Colorado potato beetle included azinphos-methyl (1.6 kg a.i./ha), carbofuran (1.16 kg a.i./ha), methyl parathion (1.64 kg a.i./ha), phosmet (2.24 kg a.i./ha), and endosulfan (1.6 kg a.i./ha). Fungicides applied included mancozeb (2.24 kg a.i./ha) and chlorothalonil (1.9 kg a.i./ha). Vine killing during the first week of September in both years was accomplished with diquat (0.28 kg a.i./ha) plus a non-ionic surfactant.

Seed Preparation and Planting

Certified "A" (4.7 cm - 8.3 cm) and "B" (<4.7 cm) seed tubers of Monona and Atlantic cultivars were used in both years. All seed tubers came from the same source. Seed storage conditions prior to the date received in Columbus, OH are not known. Once received, all seed tubers were placed in dark storage at 8 C and 85±10% RH until preparation.

Whole ("B") seed tubers were sorted by weight into four classes; *i.e.* 30 g - 38 g, 39 g - 47 g, 48 g - 54 g, and 55 g - 62 g with means of 35 g, 43 g, 51 g, and 58 g, respectively. A composite of these classes (unsorted "B" seed, mean weight = 48 g) was included as a standard for comparison. Tubers in the "B" seed lot in both years did not significantly differ in size, weight, or number of eyes (Kleinhenz, 1990).

Whole seed tubers had minimum exposure to warm, lighted conditions during sorting and thereafter seed tubers were held in dark storage at 8 C in open containers.

Whole seed tubers were warmed to room temperature approximately 24 hours before planting. The two planting dates were May 5 (P1) and June 9 (P2) in 1988 and May 18 (P1) and June 26 (P2) in 1989.

"A" seed was removed from storage, cut into approximately 56 g pieces, treated with fungicide (8% mancozeb dust) and warmed to room temperature. Cut seed pieces in 1988 were prepared and warmed 16 (P1) and 48 (P2) hours before planting. "A"-size tubers in 1989 were warmed for 24 hours before being cut and fungicide-treated.

Wet soil conditions prevented planting on planned dates in 1989. Seed tubers and pieces were removed from and placed back into storage several times, especially before P2. However, sprout growth was minimal and the seed remained firm and in suitable condition for planting.

Test plots in both years were planted in the same soil type in which rye had been planted as a plow-down winter cover crop. Twenty-five and 32 seed pieces or tubers were planted per row in 1988 and 1989, respectively. Within-row spacing was 30 cm, with 91 cm between rows in both years. A single-row cup-type planter was used.

In-Season Data Collection

Plant growth and tuber development were recorded at several points during the growing season. Measurements included emergence rate, number of main stems, leaf area (LFAREA), and dry weight of total plant biomass, minus tubers, (TDWT). The number of tubers ($<$ and $>$ 1 cm in diameter) per hill were also recorded. Main stems were defined as those arising directly from the seed piece or tuber. A hill was defined as all plants arising from a single seed piece or tuber. Emergence data were taken weekly until four weeks after planting. Plant growth measurements were taken when 50% of the stand was in bloom in both years. Measurements were also taken at 10 and 25 days after 50% emergence (DAE) in 1989.

All measurements except emergence rate required destructive sampling of two plants per plot (row) at each sampling. With five replications per planting, a total of ten plants per treatment were randomly selected at each in-season sampling. The center 6.1 m of each row was marked and reserved for final tuber yield data. Plants for in-season measurements were taken from the ends of each row (approx. 2 m at each end). In-season sampling involved removal of all soil 30 cm deep midway between the sampled plant and adjacent plants and to the bottom of the hill containing the sampled plant. Plants were hand-collected and immediately placed intact in plastic bags and away from direct sunlight. The bagged plants were then placed in cool, dark storage for 1-10 days during data collection.

All plant biomass was rinsed clean in the lab and main stems were counted. Tubers were collected, sorted by size, and counted. For LFAREA data, all expanded leaflets and portions of petiole less than 4 mm in diameter were passed through an LI-3100 Area Meter (LI-COR, Inc. Lincoln, Neb., USA) set for 1/1000 cm^2 accuracy. Recently emerged but unopened leaflets located in clusters or whorls at shoot apices were not included in the LFAREA readings. Some plants taken at the earliest samplings in 1989 did not have measurable leaf area by these criteria. Foliage was oven-dried for 4-7 days at 80 C, for dry weight determinations.

Final Harvest and Grading

Single-row field plots were machine-harvested 2-4 weeks after vine death using a single-row harvester. Total yield per 6.1 m harvest row was recorded in the field. Tubers were placed in 85% RH dark storage at 13 C until grading approximately four weeks after harvest. Tubers were graded for percent U.S. No. 1 ($>$4.7 cm), B-grade ($<$4.7 cm), and culls (misshapened, skin greening, decayed). Both plantings of 1988 were graded. However, only the first planting of 1989 could be graded. Excessive soil moisture until approximately five weeks after P2 in 1989 resulted in severely reduced yields with an insufficient number of tubers for accurate grading.

Statistical Analysis

Data collected at bloom in both years were pooled for analysis and analyzed separately by year. Analysis of 1989 data included those collected at 10 and 25 days after 50% emergence (DAE) in addition to those collected at bloom. The General Linear Models procedure F-test of Statistical Analysis System (25) was used to determine significance of main effects and interactions for the variables measured. Tukey's (HSD 0.05) Studentized Range Test (25) was used to separate means of main effects of year, planting date, cultivar, and seed treatment (seed class). Main effect interactions (cultivar × seed treatment, cultivar × year, seed treatment × year) are discussed when significant.

Results

Results are presented in two sections. The first describes the response of plant growth parameters and the second section outlines the response of yield variables. All measurements except percent stand and total and U.S. No. 1 yields are expressed on a per hill basis.

Influence of cultivar and seed treatment on number of main stems, leaf area, total plant dry weight (minus tubers), and percent stand.

A significantly greater number of main stems were produced by Atlantic as compared to Monona. This effect was noted when data collected at bloom in both years were pooled for analysis (Table 1) and when data collected at three points in the 1989 growing season were analyzed separately (Table 2). Although Monona showed significantly greater leaf area than Atlantic in pooled data (Table 1), Atlantic had greater leaf area at all sampling events in 1989 (Table 2). Differences between cultivars in total plant dry weight (TDWT) were not significant for pooled data (Table 1) but Atlantic had significantly greater TDWT at all sampling events in 1989 (Table 2).

Percent stand at week four in pooled 1988-1989 data for the 51 g and 58 g whole tuber treatments was significantly greater compared to the cut seed value (Table 3). Also, percent stand at week four in 1988 was significantly greater for the 43 g, 51 g, and 58 g whole seed compared to cut seed (Table 3). Percent stand at weeks 1-4 in 1989 did not differ significantly among seed treatments (Table 3).

Cut seed produced significantly fewer main stems per hill compared with 51 g whole seed in pooled data (Table 1). Differences among whole tuber treatments in main stems were typically not significant for pooled

TABLE 1.—*Effects of year, planting date, cultivar, and seed treatment (whole, cut) on potato plant growth variables measured at bloom.*

Sources	No. Main Stems	Leaf Area (cm^2)	Total Plant Dry Wt. (g)[1]
Year			
1988	2.4 a[2]	6229 a	64.9 a
1989	1.9 b	4039 b	31.1 b
HSD (0.05)	0.2	695	4.0
Planting Date			
Early	2.1 a	4215 b	44.2 b
Late	2.1 a	7832 a[3]	51.8 a
HSD (0.05)	0.2	756	4.0
Cultivar			
Atlantic	2.4 a	4885 b	47.5 a
Monona	1.8 b	5722 a	49.3 a
HSD (0.05)	0.2	690	4.0
Seed Treatment			
whole 35g	2.0 ab	4887 a	45.0 a
whole 43g	2.1 ab	4880 a	44.9 a
whole 51g	2.4 a	6482 a	53.6 a
whole 58g	2.1 ab	5375 a	50.4 a
cut 56g pcs	1.9 b	4962 a	48.1 a
unsorted "B"	2.3 ab	5172 a	49.0 a
HSD (0.05)	0.5	1753	10.2
Grand Mean	2.1	5390	48.3

[1]Minus tubers.
[2]Means within the same column and main effect and containing the same letter are not significantly different by Tukey's (HSD) test at $P<0.05$.
[3]1988 data only.

and nonpooled data (Tables 1, 2), although 35 g whole seed produced significantly fewer main stems per hill at bloom (1989) compared with unsorted "B" seed (Table 2).

Differences among all treatments for pooled LFAREA data collected at bloom were not significant (Table 1). However, significant differences in LFAREA were evident among whole and cut seed treatments at 10 and 25 DAE in 1989 (Table 2). Plants grown from whole 51 g and unsorted "B" seed had greater LFAREA than those grown from cut seed at 10 DAE in 1989. Further, cut seed showed significantly reduced LFAREA at 25 DAE in 1989 compared with whole 43 g, 51 g, 58 g and unsorted "B" seed (Table 2). Differences among all treatments in LFAREA were not significant at bloom in 1989, although the 51 g whole tuber treatment had more than twice the LFAREA as plants from 56 g cut seed pieces (Table 2). High variability in the data precluded statistical significance in this case.

Differences among treatments in total plant dry weight (minus tubers) were not significant in pooled 1988-1989 data (Table 1). However, several

TABLE 2.—*Effects of planting date, cultivar, and seed treatment (whole, cut) on potato plant growth variables in 1989.*

Sources	—No. Main Stems—			—Leaf Area (cm²)—			—Total Plant DWT (g)—		
	DAE[1]		Bloom	DAE		Bloom[2]	DAE		Bloom
	10	25		10	25		10	25	
Planting Date									
Early	2.0 a[3]	1.9 a	1.9 a	261 b	1956 b	4039	4.3 b	19.2 b	37.6 a
Late	1.7 b	1.9 a	1.8 a	575 a	2474 a	—	7.0 a	26.6 a	26.6 b
HSD (0.05)	0.2	0.2	0.2	122	331	NE[4]	1.2	3.1	4.7
Cultivar									
Atlantic	2.0 a	2.1 a	2.1 a	662 a	3042 a	4844 a	8.3 a	31.6 a	40.2 a
Monona	1.6 b	1.7 b	1.6 b	284 b	1445 b	2752 b	3.8 b	14.8 b	20.5 b
HSD (0.05)	0.2	0.2	0.2	115	331	1233	1.2	3.1	4.7
Seed Treatment									
whole 35g	1.8 ab	1.6 b	1.6 b	436 ab	2045 ab	3729 a	5.3 ab	20.7 ab	28.3 ab
whole 43g	1.7 ab	1.8 ab	1.8 ab	527 ab	2202 a	3388 a	6.1 a	23.7 a	26.8 ab
whole 51g	1.9 a	2.0 ab	2.0 ab	540 a	2478 a	5211 a	7.3 a	25.2 a	37.6 a
whole 58g	1.8 ab	2.3 a	2.0 ab	476 ab	2505 a	4517 a	6.1 a	26.6 a	32.9 ab
cut 56g	1.4 b	1.5 b	1.6 b	237 b	1292 b	2536 a	3.1 b	13.3 b	23.8 b
unsorted "B"	2.0 a	1.9 ab	2.2 a	627 a	2833 a	4716 a	8.2 a	28.5 a	36.2 a
HSD (0.05)	0.5	0.5	0.6	292	838	3087	3.0	7.9	11.8
Grand Mean	1.8	1.9	1.9	463	2227	3970	6.5	23.0	31.1

[1]Days after 50% emergence.
[2]Planting one data.
[3]Means within the same column and main effect and containing the same letter are not significantly different by Tukey's (HSD) test at $P<0.05$.
[4]Cannot be estimated.

TABLE 3.—*Percent stand of potato seedlings grown from whole and cut seed at 1-4 weeks after planting at Wooster, OH. Values are means of two planting dates (May, June) and cultivars (Atlantic, Monona).*

	——Year and Week After Planting——								
	1988		1989				pooled 1988-89		
	3	4	1	2	3	4	2	3	4
Seed Treatment									
whole 35g	68 a[1]	88 ab	7 a	19 a	58 a	87 a	14 b	62 a	88 ab
whole 43g	74 a	92 a	6 a	21 a	52 a	85 a	18 ab	60 a	88 ab
whole 51g	64 a	93 a	8 a	24 a	68 a	91 a	23 a	67 a	92 a
whole 58g	65 a	92 a	10 a	24 a	59 a	86 a	17 ab	61 a	89 a
cut 56g pcs.	59 a	81 b	4 a	12 a	55 a	80 a	11 b	56 a	81 b
unsorted "B"	68 a	90 ab	5 a	21 a	60 a	87 a	17 ab	63 a	88 ab
HSD (0.05)	24	9	9	12	20	14	8	15	8
Grand Mean	66	89	7	20	59	86	17	62	88

[1]Means within the same column and containing the same letter are not significantly different by Tukey's (HSD) test at $P<0.05$.

whole tuber treatments had significantly greater TDWT than the cut seed treatment at vegetative harvests in 1989 (Table 2).

Significant cultivar × year interactions ($P < 0.01$) were noted for leaf area and total plant dry weight measured at bloom in both years (data not shown). LFAREA for Monona in 1988 was 7342 cm^2 compared with 4928 cm^2 for Atlantic. However, LFAREA for Atlantic in 1989 was 5101 cm^2 compared with 2967 cm^2 for Monona. Total plant dry weight values followed the same pattern. Monona values were higher in 1988 and Atlantic values were higher in 1989. Total plant dry weight per hill (minus tubers) for Monona in 1988 was 72.5 g compared with 55.8 g for Atlantic. Total plant dry weight for Atlantic in 1989 was 41.7 g compared with 21.5 g for Monona (data not shown).

Influence of cultivar and seed treatment on tuber number and size distribution per hill, total yield, and U.S. No. 1 yield.

Monona showed a significantly greater number of tubers per hill (>1 cm in diameter) than Atlantic in pooled data (Table 4). Despite mid-season advantages in tuber number, Monona had significantly reduced total and U.S. No. 1 yield compared with Atlantic. This effect was evident in pooled data (Table 5) and when data from each year were analyzed separately (data not shown). Monona produced a significantly greater number of tubers (>1 cm in diameter) in 1988 while Atlantic produced significantly more in 1989 (Table 4).

Data collected at bloom and pooled for analysis showed that all whole seed classes produced 1.6-3.3 more tubers (>1 cm in diameter) per hill compared with the cut seed treatment (Table 4). These differences were significant ($P < 0.05$). Similar trends were recorded in 1988 and 1989 data (Table 4). Unsorted "B" seed produced an average of 10 total tubers per hill at bloom in 1989 while the cut seed treatment produced an average of 5 total tubers per hill (Table 4). Differences among whole seed treatments in the number of tubers > 1 cm in diameter at bloom were rarely significant in pooled data (Table 4). Despite differences in the number of tubers per hill counted at bloom in both years, significant differences among all treatments in total and U.S. No. 1 yield were not observed (Table 5).

The cultivar × year interaction for tubers > 1 cm in diameter at bloom was significant ($P < 0.01$). Monona had an average of 9.5 tubers per hill in 1988 compared with 3.4 for Atlantic (Table 4). However, Atlantic showed an average of 6.0 tubers per hill in 1989 compared with 4.6 for Monona (Table 4).

Discussion

Collins (1977) suggested that dry matter production is related to leaf area from emergence to tuberization. The 1989 data of this experiment are partly consistent with those of Collins (1977). Increased TDWT was

TABLE 4.—*Effects of planting date, cultivar, and seed treatment (whole, cut) on potato tuber number and size distribution per hill in 1988, 1989, and pooled data.*

	Number of Tubers						
	1988	1989					pooled 1988-89
	>1 cm	<1 cm	>1 cm	Total			>1 cm
Sources	Bloom	Bloom	Bloom	DAE[1] 10	DAE[1] 25	Bloom	Bloom
Planting Date							
Early	5.2 b[2]	4.0 a	5.3 a	–	6.3 a	9.3 a	5.3 b
Late	8.1 a	3.4 a	5.3 a	0.2	5.7 a	8.6 a	6.6 a
HSD (0.05)	1.0	0.8	0.9	NE[3]	1.4	1.3	0.7
Cultivar							
Atlantic	3.4 b	2.9 b	6.0 a	0.4 a	6.7 a	8.9 a	4.8 b
Monona	9.5 a	4.5 a	4.6 b	0 b	5.3 b	9.0 a	7.0 a
HSD (0.05)	1.0	0.8	0.9	0.3	1.4	1.3	0.7
Seed Treatment							
whole 35g	6.3 ab	3.2 ab	5.1 ab	0.1 ab	5.1 ab	8.4 abc	5.8 ab
whole 43g	6.5 ab	3.4 ab	4.7 ab	0.2 ab	5.3 ab	8.1 bc	5.6 b
whole 51g	8.0 a	5.0 a	6.7 a	0.3 ab	7.4 a	11.7 a	7.3 a
whole 58g	8.0 a	4.3 a	6.2 a	0.1 ab	8.2 a	10.5 ab	6.9 ab
cut 56g pcs	4.9 b	2.1 b	3.1 b	0 b	2.8 b	5.1 c	4.0 c
unsorted "B"	7.1 ab	4.2 a	6.0 a	0.8 a	7.3 a	10.2 ab	6.4 ab
HSD (0.05)	2.6	1.9	2.2	0.8	3.5	3.4	1.7
Grand Mean	6.7	3.7	5.3	0.2	6.0	9.0	6.0

[1]Days after 50% emergence.
[2]Means within the same column and main effect and containing the same letter are not significantly different by Tukey's (HSD) test at $P<0.05$.
[3]Cannot be estimated.

associated with increased LFAREA through 25 DAE. However, a similar relationship was not present at bloom (Table 2).

Yield may also be effected by the rate and duration of LFAREA production. Bremner and Taha (1966) suggested that yield is most effected by the duration of the leaf growth period and less by the amount of LFAREA produced. In our experiment, vine killing was accomplished before senescence. Therefore, yield values were expected to correlate with the rate of LFAREA production until tuberization. The 1989 data did not support this expectation. At least two whole tuber treatments had greater LFAREA at 10 and 25 DAE in 1989 compared with the cut seed treatment (Table 2). However, greater yield for these treatments was not obtained (Table 5).

Similar studies have shown that total and marketable yield may be related to both the mean weight of seed pieces and the uniformity of seed piece weight within a seed lot (21, 30). Data of the present study support these findings in part for cvs. Monona and Atlantic under the experimen-

TABLE 5.—*Effects of year, planting date, cultivar, and seed treatment (whole, cut) on total and U.S. No. 1 potato tuber yield.*

Sources	Tuber Yield (t/ha) Total	U.S. No. 1
Year		
1988	31.1 a[1]	8.9 a[2]
1989	12.8 b	3.2 b
HSD (0.05)	4.0	1.3
Planting Date		
Early	28.0 a	7.9 a
Late	30.5 a	8.7 a
HSD (0.05)	2.5	0.8
Cultivar		
Atlantic	31.4 a	9.2 a
Monona	27.3 b	7.4 b
HSD (0.05)	2.5	0.8
Seed Treatment		
whole 35g	28.7 a	8.3 a
whole 43g	30.5 a	8.6 a
whole 51g	30.2 a	8.6 a
whole 58g	30.2 a	8.7 a
cut 56g pcs.	27.8 a	7.7 a
unsorted "B"	27.3 a	7.3 a
HSD (0.05)	6.5	2.1
Grand Mean	28.0	7.9

[1]Means within the same column and main effect and containing the same letter are not significantly different by Tukey's (HSD) test at $P<0.05$.
[2]Data in this column represent all plantings except for planting 2 of 1989.

tal conditions described. Sorted whole tuber treatments did not show significantly greater total and marketable yields in comparison to the unsorted "B" seed control (Table 5). However, sorted treatments tended to have higher yields than unsorted "B" seed. These and other data suggest that yield may improve with control of seed weight within a seed lot, regardless of seed type. For example, greater marketable yields of cv. Russet Burbank were obtained when cut seed piece weight was maintained between 28 g and 70 g (30).

Previous reports have established the relationships among stem number, tuber number, and total and marketable yields. The number of main stems in a potato stand is important (1, 3, 9, 14, 16, 20) since apparently positive relationships exist between stem population and tuber number (4, 5, 8, 10, 13, 19, 31, 32) and stem number and total yield (2, 4, 11, 16, 26, 32). However, tuber number and mean tuber weight at harvest (marketable yield) are often inversely related (4, 11, 12, 13).

Data of this study were inconclusive with respect to the findings noted above. Differences in main stems, tuber number, and yields were inconsistent. Despite few significant differences among treatments in main stems, cut seed produced significantly fewer tubers per hill compared with whole seed in both years of the experiment (Table 4). All whole seed classes produced 1.6-3.3 more tubers per hill at bloom than cut seed in pooled data. However, this trend was not evident at tuber harvest or grading. Significant differences among treatments in total and U.S. No. 1 yields were not recorded. Extreme environmental conditions in both years of the experiment may partially explain the lack of significant differences in yield parameters. High temperatures and limited soil moisture were characteristic of the 1988 season. Excess soil moisture and high populations of Colorado potato beetle limited plant growth in 1989. Differences in yield among treatments were not recorded although differences in plant and tuber variables were observed. For example, unsorted "B" seed tubers had twice the total number of tubers as cut seed at bloom in 1989 (Table 4). In spite of these mid-season results, differences in yield were absent between cut and unsorted "B" seed. Formulating relationships among stem number, tuber number, and yield for whole and cut seed in Ohio may require additional experimentation.

The weight of tuber substrate per main stem has been described as an important determinant of yield (14). This observation is not supported by our data. Small whole seed with less substrate per main stem obtained yield comparable to that of heavier whole and cut seed (Table 5).

This experiment was important in its direct comparison of development and yield of potato plants grown from cut and several weight classes of whole seed under Ohio conditions. Previous findings suggest that seed type and weight are important determinants of plant development and yield (6, 14, 16, 21, 24, 32, 33). However, others concluded that seed weight has a minor influence on yield in some cases (14, 27). The data of this experiment were inconclusive. Neither whole nor cut seed treatments had significantly greater values for all variables measured. Further, the influence of seed weight was inconsistent.

Future related studies may benefit if conducted under controlled environmental conditions. Extreme environmental conditions may have prevented expression of significant differences in this experiment. Also, recording the weight and location of individual seed tubers or pieces at planting would be of benefit in establishing relationships of seed weight, plant growth, and yield. Related work may also benefit from accounting for hill to hill variation in the statistical analysis of several variables. Previous work has shown substantial variation in the number of main stems and tubers per hill in potato plant populations (27, 29). The analysis of Silva and Andrew (1985) is a useful guide in interpreting experiment- and plot-wise variation. Finally, research has shown that apical and basal halves of

"A-grade" seed tubers effect plant growth and yield differently in some cultivars (17, 18). Separating apical and basal seed piece portions may be useful in studies comparing whole and cut seed. Finally, the threshold of whole seed tuber weight below which the variables measured in this experiment decline noticeably was not found. Seed tubers weighing 31 g - 39 g showed plant growth and yield comparable to those of 51 g - 58 g whole tubers. Similar studies conducted in controlled environments and the field may benefit from planting tubers weighing less than 31 g.

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