Turkish Journal of Field Crops
field-crops.org

DOI: 10.17557/tjfc.1706800
ISSN: 1301-1111
e-ISSN: 3023-6657
2025, 30(1), 249-256

The Potato Clones Selected for High and Low Plant Yield in the F_1 Generation of Atlantic × 101 (Nif) Cross

Muhammet Anil AYDIN[1*], Gulsum OZTURK[2], Metin Birkan YILDIRIM[2]

[1*]Ege University, Graduate School of Natural and Applied Sciences, Izmir, Türkiye
[2]Ege University, Faculty of Agriculture, Department of Field Crops, Izmir, Türkiye

✉ Corresponding author: anilaydinn10@gmail.com

ARTICLE INFO

Research Article
Received: 26 May 2025
Accepted: 22 June 2025
Published: 23 June 2025

Keywords:
Highest (Q1) quartile
Lowest (Q4) quartile
Normal distribution
Potato clonal selection
Progeny testing
Selection differential
Truncated selection

Citation: Aydin, M. A., Ozturk, G., & Yildirim, M. B. (2025). The potato clones selected for high and low plant yield in the F_1 generation of Atlantic × 101 (Nif) cross. *Turkish Journal of Field Crops*, *30*(1), 249-256. https://doi.org/10.17557/tjfc.1706800

ABSTRACT

The study aimed to compare the performances of clones selected for high low single plant yield in the greenhouse growing in the progeny test run in seedbed growing. A total of 104 plants were randomly selected among 1104 F_1 plants and tuber yield of each plant was measured and the tubers were kept as clone. Assuming a normal distribution, the truncated selection was applied at the highest (Q_1) and lowest (Q_4) quartiles of the normal distribution at the s = 0.05; 0.10; 0.15; 0.20 and 0.25 selection pressures. Clones selected were grown in a seedbed nursery as progeny testing. The results can be summarized as follows: The progeny population could be separated into two distinct groups with mean values of 5.16 g and 1.35 g, at the s = 0.25 selection pressure. In the greenhouse the highest quartile at the s = 0.05 selection pressure had the highest mean of 6.40 g and reduced to 5.16 g at the 0.25 level. In the lowest quartile the lowest mean was 0.60 g at the s = 0.05 level and increased up to 1.35 g in the s = 0.25 level. The highest quartile (Q_1) had the mean 49.51 g at s = 0.05 and reduced to 35.53 g in the s = 0.25. The lowest mean was obtained in the lowest quartile (Q_4) at the s = 0.05 with a value of 24.30 g and increased up to 33.85 g at the s = 0.25 level. The highest amount of the difference between the highest and the lowest selection was obtained as 25.21 g at the s = 0.05 pressure level in the seedbeds.

1. INTRODUCTION

In potato breeding, first stage of selection of individuals starts in the F_1 generation grown in the greenhouse in contrast to Pedigree breeding of cereals which starts in the F_2 population. This is a shortcut in potato breeding due to insufficient Seed production in the first generation. A clone is the tubers of a single plant F_1 plants carries the identical copy complete genetic structure. Therefore, the potato clone obtained from the tubers of the F_1 plant represent whole genetic structure. Thus, in potato breeding; a breeder can select high yielding clones as early as possible to be tested in the field growing. Since the first selection applied in the F_1 generation grown in the small pots in the greenhouse the success of selection could not be evaluated. Therefore, the progeny of the selected clones should be grown under field conditions to evaluate yielding capacity of clones (Mullin et al., 1966). In practice seeds are increased in the seedbeds or in the laboratory using meristem culture.

The success of the selection could be controlled in the progeny testing of the clones selected in the greenhouse by growing them in the seedbeds or in the field (Yildirim, 1972; 1981; Ozturk and Yildirim, 2020; Yildirim and Ozturk, 2021). The success in a potato breeding depends on the direction and duration of selection during the field testing. The success of selection and the possibility of obtaining high yielding potato genotype depends on the genetic variation of the starting clones in the F_1 generation (Konstantinova and Fadeev, 2020).

In potato breeding, yield components and other components should be combined in a potato clone before submitting it to the releasing process. Since a breeding program aims high yield the lower yielding clones have been eliminated in the first cycle of selection process (Brown et al., 1987; Brown et al., 1988; Gopal et al., 1992; Ozturk and Yildirim, 2014).

Selection theory assumes a normal distribution of individuals grown in the base population. If base population where the plant selection starts, should be assumed as a normal distribution. The success of selection applied for a quantitative trait could be evaluated by using the parameters and characteristics of a normal distribution such as mean and variance.

The F_1 plants grown in the greenhouse are ranked by their phenotypical values of some quantitative traits and certain percentages is selected. This method is called a truncated selection for quantitative traits. The difference between the means of selected individuals and the population mean $(\bar{x}_s - \bar{x}_p)$ are defined as selection differential (S). The difference between the means of the progeny testing population and the mean of starting population $(\bar{x}_p)$ is defined as genetic advance (GA) and was estimated by the $\Delta Z = h^2 \times S$ formula (Lush, 1945; Kelly, 2008; 2011). The widely used formula for genetic advance is $GA = i\sigma_P h^2$ where $i = Selection\ intensity, \sigma_P = phenotypic\ standard\ deviation\ and\ h^2 = heritability\ in\ narrow\ sense$ (Lush, 1945; Falconer, 1964; Yildirim and Ozturk, 2021).

The F_1 generation of the Clone 6/7 x 101 (Nif) crossings were grown in the greenhouse and the single plant yield of F_1 plants were evaluated and selection was applied at such as s =0.05; 0.10; 0.15; 0.20 and 0.25. The success of the selection was controlled in the seedbed growing. The results indicated that selection at high and moderate selection pressures was effective for single plant yield and tuber number. Lower selection pressure were found to be more effective for single tuber weight. Selection applied at medium level (s = 0.15) resulted in high single plant yield (Aydin and Ozturk (2022).

Selection differentials were estimated by selecting individuals with the highest (Q_1) and the lowest quartiles (Q_4) at different selection pressures (s) (0.05; 0.10; 0.15; 0.20; 0.25) in the greenhouse growing. The selected groups were compared with each other by conducting progeny control in the following seedbed nursery. As a result of the comparison, means of single plant yields for high and low value individuals were 24.02 g (s = 0.25) and 18.19 g (s = 0.05), respectively (Yilmaz, 2023).

The purpose of this study was to compare the performance of the F_1 clones selected for the highest and the lowest ends of a normal distribution for single plant yield in the greenhouse by growing them in the progeny testing stage grown in the seedbed nursery.

2. MATERIALS AND METHODS

The study was conducted in the laboratory, greenhouse and seedbeds of the Department of the Field Crops of the Ege University in 2022 and 2023. The temperature and precipitation values of Bornova in 2022 and 2023 are given in Figure 1 (Anonymous, 2023).

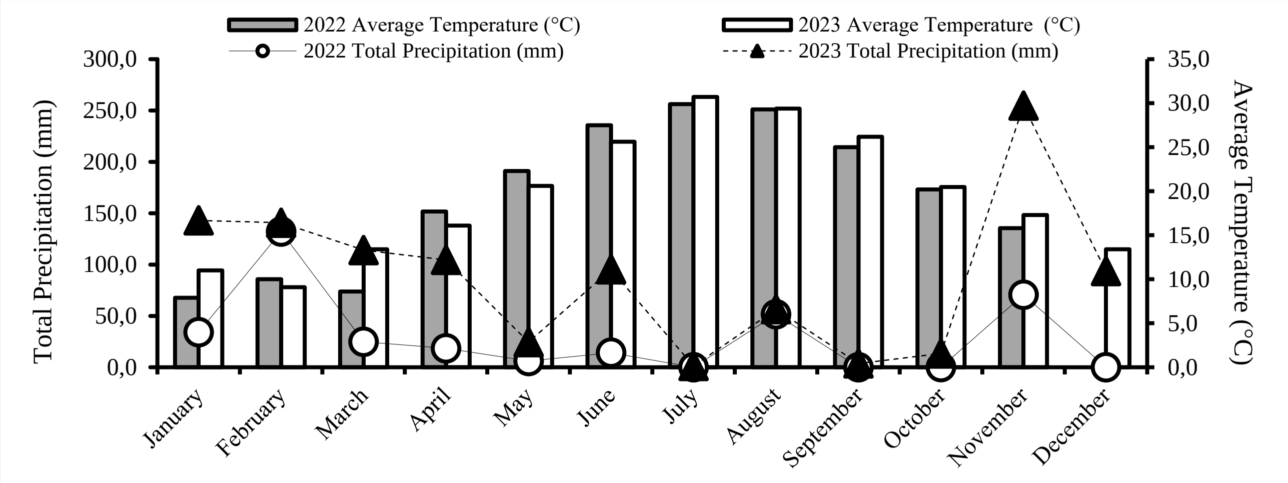

Figure 1. Average monthly temperature (°C) and total monthly precipitation amounts (mm) for the 2022 and 2023 growing seasons at the trial site (Anonymous, 2023)

True potato seeds (TPS) obtained from the cross of Atlantic x 101 (Nif) were used in the study certain characteristics of parents and single plant yield, tuber number and single tuber weight of the parents are shown in Table 1 and Table 2.

Table 1. Certain characteristics of parents

Genotype	Parentage	Characteristics
Atlantic	Wauseon x Lenape	Medium-late, medium dormancy, abundant flowering (light lavender), high-quality pollen, oval-round tubers, white skin and flesh color, medium shallow tuber eye depth, high dry matter content, low total glycol alkaloid level (Webb et al., 1978; ECPD, 2025)
101 (Nif)	Cosima x R.143	Medium early, productive, oval tuber, 23.4% dry matter and 16.8% starch, high flower and fruit production (Ozturk and Yildirim, 2020)

Table 2. Mean of the tuber number, the single tuber weight (g), and the plant yield (g) of parents measured in pots and seedbeds

Parents	GREENHOUSE GROWING			SEEDBED GROWING		
	Tuber number	Single tuber weight (g)	Single Plant yield (g)	Tuber number	Single tuber weight (g)	Single Plant yield (g)
Atlantic	1.80	1.80	3.24	1.80	9.30	16.74
101 (Nif)	2.00	2.20	4.40	2.20	11.50	25.30

Crossing and growing the True Potato Seeds (TPS) in the greenhouse

The crossings of Atlantic x 101 (Nif) were completed in the spring period of 2022 in the seed laboratory of Department of Field Crops at Ege University.

Fruits harvested were squeezed and 2510 TPS were obtained. The TPS of the cross and the parents were grown in $10x20$ cm pots in November 2022 and 1104 plantlets were grown and the seedlings were transferred to plastic pots containing mixture of soil and turf in 2: 1 ratio. Each individual pot contained one single potato plant.

A total of 104 plants were randomly selected and harvested separately and their tuber were recorded and saved as clone. The clones were measured for the single plant yield, tuber number and single tuber weight.

The selected clones were grown in seedbeds in September, 2023. Plot size was a single row in 1.5 m length. Planting was done in $30\ x\ 50$ cm. Normal growing procedures were applied and the seedbeds were harvested by hand on December 26, 2023. The single plant yield, tuber number and single tuber weight was recorded.

Statistical evaluation of clonal data obtained in the greenhouse

The population of 104 clones assumed to be in normal distribution and the following parameters were estimated as given by Yildirim and Ozturk (2021).

$\boldsymbol{n}$: number of individual clones

$\bar{\boldsymbol{x}}$: average

$$\bar{\boldsymbol{x}} = \sum \frac{x_i}{n}$$

$$\textbf{Variance } (s^2) = \frac{\sum x_i^2 - \frac{(\sum x_i)^2}{n}}{n-1}$$

$$\textbf{Standard deviation } (s) = \sqrt{s^2}$$

$$\textbf{Standard error of mean } (s_{\bar{x}}) = \sqrt{\frac{s^2}{n}}$$

$$\textbf{Selection Differential} = \bar{x}_{selected} - \bar{x}_{base\ population}$$

$$\boldsymbol{z} = \frac{\bar{x}_{selected} - \bar{x}_{base\ population}}{s}$$

$$\boldsymbol{i} = \frac{z}{p} \quad where \ \ \boldsymbol{p} = 1 - s \ \ (s{:}\,selection\ ratio\ applied\ such\ as\ \ 0.05;\ 0.10;\ 0.15;\ 0.20 \text{ and } 0.25)$$

3. RESULTS AND DISCUSSION

The distribution of the single plant yields of the selected 104 clones of Atlantic x 101 (Nif) cross grown in the greenhouse is shown in Figure 2.

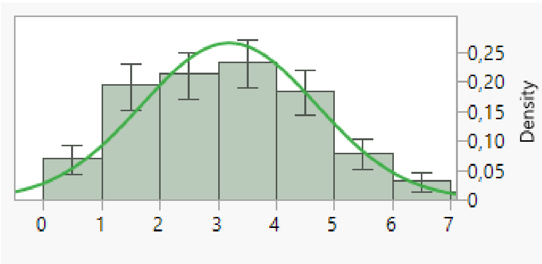

Figure 2. Distribution of the single plant yield of randomly selected potato clones in the greenhouse

It could be seen in Figure 2 that the distribution of single plant yield of clones could be in a normal distribution in the greenhouse.

The results of simple statistical evaluation of data for the single plant yield in the greenhouse and seedbed nursery growing are shown in Table 3.

Table 3. Estimates of simple statistics of the normal distribution for 104 potato clones grown in the greenhouse (base) and progeny testing in the seedbeds

Characteristics	Number of individuals (n)		Range (min.-max. value)		Mean ($\bar{x}$)		Standard deviation (s)	
	G1	SB	G1	SB	G1	SB	G1	SB
Single plant yield (g)	104	104	0.33-7.02	1.51-110.62	3.20 ± 0.15	35.86 ± 2.65	1.50	27.07
Single tuber weight(g)	104	104	0.33-2.82	1.51-37.34	1.39 ± 0.05	15.70 ± 0.93	0.51	9.45
Tuber number	104	104	1-4	1-4	2.34 ± 0.09	2.21 ± 0.10	0.91	1.00

G1: Greenhouse Generations, SB: Seedbed Growing

It could be observed in the Table 3 that the single plant yields of potato clones in the greenhouse ranged as 0.33 g – 7.02 g; single tuber weight ranged in 0.33 g – 2.82 g and tuber number ranged as 1 - 4 interval. Similarly, ranges were 1.51 g – 110.62 g, 1.51 g – 37.34 g and 1 – 4 for single plant yield, single tuber weight and tuber number respectively in the seedbed growing. Since the single plant yield is accepted as a yield component and the other two traits are correlated with single plant yield we will focus on comparing the single plant yield of two opposite selections applied at the values varying of the selection pressure in the greenhouse with their means in the seedbed growing.

The population mean and the selection differentials estimated for the highest and the lowest quartiles for clone yields in the greenhouse and seedbed growing are shown in Table 4 and Table 5.

Table 4. Means of selected groups and selection differentials estimated for the highest and the lowest quartiles in the greenhouse growing at different selection pressure(s)

			Highest (Q_1)		Lowest (Q_4)	
Selection pressure (s)	**Selection intensity (i)**	**Population mean ($\bar{x}$) (g)**	**Mean of selected (g)**	**Selection differential (SD) (g)**	**Mean of selected (g)**	**Selection differential (SD) (g)**
0.05	2.06	3.20	6.40 ± 0.17	3.20	0.60 ± 0.08	|-2.60|
0.10	1.83	3.20	6.01 ± 0.16	2.81	0.84 ± 0.10	|-2.36|
0.15	1.69	3.20	5.64 ± 0.16	2.44	1.08 ± 0.10	|-2.12|
0.20	1.61	3.20	5.38 ± 0.16	2.18	1.24 ± 0.10	|-1.96|
0.25	1.53	3.20	5.16 ± 0.16	1.96	1.35 ± 0.09	|-1.85|

It could be seen in Table 4 that the highest selection differential (SD) was 3.20 g in the highest quartile (Q_1) at the s = 0.05 level and the lowest selection differential in the lowest quartile (Q_4) was |-2.60| g. The values of selection differentials for s = 0.10 (2.81 g), s = 0.15 (2.44 g), s = 0.20 (2.18 g) and s = 0.25 (1.96 g) in the selection pressure from the highest level and |-2.36|, |-2.12|, |-1.96| and |-1.85| in the selection pressure in the lowest level respectively.

The highest mean for selected clones at the s = 0.05 was 6.40 g in the highest quartile and 1.35 g at the s = 0.25 selection pressure in the lowest quartile.

The selection differentials observed in Table 4 were as expected. At the s = 0.05 level, the highest group exhibited a selection differential of 3.20 g, while the lowest group showed |-1.85| g. At the s = 0.25 level, these differentials decreased from 3.20 to 1.96 g and increased to |-2.60| to |-1.85| g, selected in the Q_1 and Q_4 quartiles respectively.

The mean of single plant yield obtained in the greenhouse growing and its progeny testing results of following stage at various selection pressure were compared in Table 5. The increases in the mean of selected group in the seedbed growing were positive and descending order from s = 0.05 to s = 0.25, except for s = 0.10. Such as 6.40 g and 49.51 g at the s = 0.05 level but 52.46 at the s = 0.10 selection pressure level.

Table 5. Selection differentials obtained for the highest (Q_1) and lowest (Q_4) quartiles in the greenhouse and their mean values obtained in the seedbed growing conditions

		Highest (Q_1)				Lowest (Q_4)			
Selection pressure (s)	**Selection intensity (i)**	**Selection differential (greenhouse) (g)**	**Mean of selected (greenhouse) ($\bar{x}_{G1}$) (g)**	**Mean of seedbed ($\bar{x}_{SB}$) (g)**	**Gain (g)**	**Selection differential (greenhouse) (g)**	**Mean of selected (greenhouse) ($\bar{x}_{G1}$) (g)**	**Mean of seedbed ($\bar{x}_{SB}$) (g)**	**Gain (g)**
0.05	2.06	3.20	6.40	49.51 ± 16.13	46.31	|-2.60|	0.60	24.30 ± 4.97	21.70
0.10	1.83	2.81	6.01	52.46 ± 10.72	49.65	|-2.36|	0.84	31.32 ± 4.80	28.96
0.15	1.69	2.44	5.64	42.46 ± 7.89	40.02	|-2.12|	1.08	32.89 ± 6.33	30.77
0.20	1.61	2.18	5.38	35.85 ± 6.56	33.67	|-1.96|	1.24	34.05 ± 5.40	32.09
0.25	1.53	1.96	5.16	35.53 ± 5.93	33.57	|-1.85|	1.35	33.85 ± 5.10	32.00

The similar conclusion could be valid in the lowest side selection such as the mean was 0.60 g and 24.30 g in the greenhouse and seedbed growing at the 0.05 level, respectively. Means of selected groups were in decreasing order except from s = 0.20 to s = 0.25 on the contrary, it was from low to high in the seedbed growing.

There is a lack of information based on actual study on comparing lowest and highest selection pressures in the literature related to potatoes. We can give some agreed results with s = 0.25 in Yildirim (1980) wheat, Cagirgan (1989) barley and Kelly (2011) yellow monkeyflower (*Mimulus guttatus*).

Aydin and Ozturk (2022) reported that the highest level of selection in the greenhouse was 7.70 g at a s = 0.05 selection pressure for high side. Yilmaz (2023) reported that the highest mean of the single plant yield was 11.14 g at s = 0.05 level and lowest single plant yield at the same pressure level was 1.76 g. In this study the discrepancies were found at the s = 0.10 level in the highest and s = 0.25 level. These discrepancies supported Bradshaw et al. (1998), who reported that the clonal selection could not succeed without additional selection application in the progeny testing stage and the following selection periods.

Another comparison of high and low level selection of clones in the base and progeny population are shown in Table 6. This table indicates a clear increase in the means of a single plant yield during seedbed growing.

In Table 6 we could also observe certain discrepancies in the high side and low side selection groups such as clone 40-133 had 5.74 g in the greenhouse but had 100.30 g single plant yield in the seedbed growing. The single clone has caused 52.46 g in the s = 0.10 in Table 5.

In general, we expect means reduced in accord with selection pressure from 0.05 to 0.25; at the highest quartile we also expect increased means from s = 0.05 to 0.25 in the lowest selection side, but the single plant yields had a variable trend in two selection procedures.

Table 6. Single plant yields of the clones at 0.05; 0.10; 0.15; 0.20 and 0.25 selection pressure for the highest (Q_1) and the lowest (Q_4) selection groups grown in the greenhouse and in the seedbeds

	HIGH LEVEL (Q_1)			LOW LEVEL (Q_4)		
No	**Clone**	**Greenhouse (g)**	**Seedbeds (g)**	**Clone**	**Greenhouse (g)**	**Seedbeds (g)**
1	40-105	7.02	71.78	40-183	0.33	36.92
2	40-89	6.47	44.57	40-261	0.50	9.76
3	40-223	6.33	97.11	40-19	0.66	16.17
4	40-17	6.21	4.54	40-356	0.74	31.12
5	40-342	5.99	29.57	40-241	0.75	27.53
6	40-250	5.80	3.80	40-27	0.82	54.57
7	40-133	5.74	100.30	40-341	0.95	46.24
8	40-92	5.56	45.40	40-262	1.14	11.77
9	40-252	5.51	55.70	40-13	1.23	44.72
10	40-361	5.45	71.87	40-171	1.30	34.41
11	40-103	5.38	8.64	40-162	1.30	34.90
12	40-215	5.00	51.04	40-156	1.45	110.62
13	40-369	4.98	33.43	40-111	1.47	3.32
14	40-333	4.96	44.39	40-50	1.54	15.51
15	40-357	4.91	6.19	40-104	1.55	32.62
16	40-66	4.91	11.01	40-275	1.61	16.04
17	40-57	4.67	14.63	40-65	1.69	60.20
18	40-126	4.60	6.50	40-35	1.70	12.76
19	40-338	4.54	18.50	40-135	1.72	57.17
20	40-326	4.53	10.64	40-52	1.75	8.00
21	40-263	4.39	23.34	40-240	1.78	50.78
22	40-214	4.35	71.68	40-244	1.80	10.73
23	40-8	4.29	4.26	40-101	1.80	71.08
24	40-119	4.25	72.39	40-43	1.81	11.07
25	40-90	4.23	14.13	40-3	1.84	3.09
26	40-29	4.17	8.43	40-173	1.85	68.94

In plant breeding individual plant selection was applied assuming a normal distribution and high individuals with high value are selected following a truncated selection procedure. The success of selection depends on the additive variation and could be controlled by growing the selected individual in the following stage, such as progeny testing. In this study the clones of lowest section of the base population (greenhouse) were also chosen to compare the success probability of selection applied at two reverse directions.

This type of selection could help increase the genotypic variation and could be beneficial in the field evaluation to control some unexpected variation. For example, clones 40-156 (110.62 g) have surpassed the highest plant yield, 40-133 (100.30 g), indicating some possibilities for increasing genetic variation. This type of differences could not be explained easily. Some experimental deficiencies as well as some epigenetic factors could be effective during the growing period (Bradshaw et al., 1998).

The mean of single plant yields of the highest and the lowest selection ratios are shown in Figure 3. Also, the difference between the highest and the lowest levels of selection at the base and progeny populations are shown in Figure 4.

The difference between selection at the s = 0.05 pressure level of the highest side and selection of the lowest side was 25.21 g. This could be accepted a clear cut difference obtained in the progeny control.

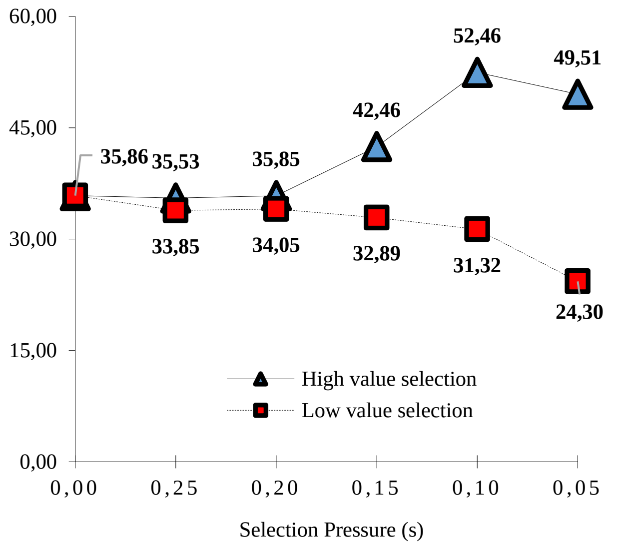

Figure 3. The single plant yield of the clone selected at high side and low side selection in the seedbeds

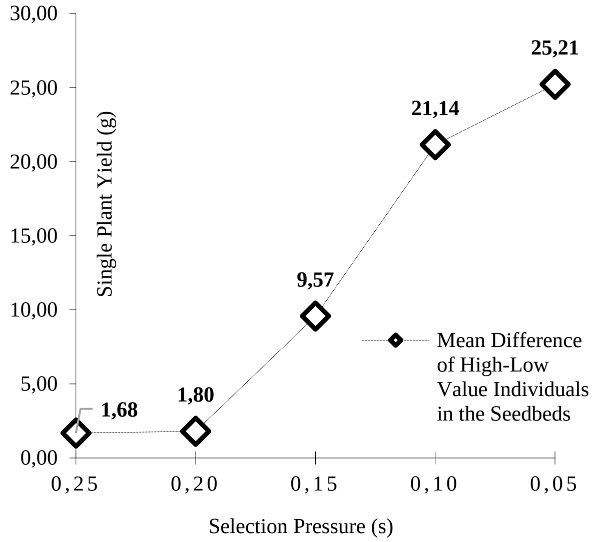

Figure 4. The differences between the means of selected groups at highest and lowest sides in increasing order from s = 0.05 to s = 0.25 level

4. CONCLUSION

Based on the comparison of the mean performance of selected single plants from the highest and lowest quartiles in the F_1 generation and their corresponding means in the seedbed nursery, the following conclusions can be drawn: Selection pressure at the s = 0.05 level applied for single plant yield in the greenhouse growing resulted in high means in the seedbed growing stage (49.51 g). Similarly, the lowest selection pressure applied at the same level in the following stage resulted in low mean in the seedbed control, such as 33.85 g. It could be generalized that mean of the selected groups from the 0.05 to the 0.25 level pressure decreased in the highest side of the application (6.40 g - 5.16 g) on the contrary, the mean of the selected groups increased from low to high in the lowest side (Q_4) such as (0.60 g – 1.35 g).

The apparent difference between the effect of low and high level selection for single plant yield resulted in the clear-cut differences at the s = 0.05 pressure level, such as 6.40 g and 0.60 g as expected.

Some discrepancies encountered in the selection procedure include high plant yields in the high and low pressure groups such as 100.30 g in the highest part and 110.62 g in the lowest part.

To cope with this kind of unexpected results, selection pressure could be reduced down to moderate levels such as s = 0.10 – 0.15 in practical breeding procedure. In this study the difference between the highest and the lowest selected groups has resulted in as expected levels. If the aim is to establish a successful potato breeding program, applying moderate selection pressures—such as s = 0.20 – 0.25 can be advisable during the greenhouse selection stage.

ACKNOWLEDGEMENT

We would like to extend our heartful thanks to the Department of Field Crops, Faculty of Agriculture, Ege University, for providing us with the academic environment, resources, and steady support which greatly contributed to the progress and completion of this study.

REFERENCES

Anonymous. (2023). Izmir Regional Directorate of Turkish State Meteorological Service. https://www.mgm.gov.tr

Aydin, M. A., & Ozturk, G. (2022). Clone selection based on yield components in the first generation of 6/7 Clone × 101 potato (*Solanum tuberosum* L.) cross. ANADOLU Journal of Aegean Agricultural Research Institute, 32(1), 40-49. https://doi.org/10.18615/anadolu.1129968

Bradshaw, J. E., Dale, M. F. B., Swan, G. E. L., Todd, D., & Wilson, R. N. (1998). Early-generation selection between and within pair crosses in a potato (*Solanum tuberosum* subsp. *tuberosum*) breeding programme. *Theoretical and Applied Genetics, 97*(8), 1331–1339. https://doi.org/10.1007/s001220051030

Brown, J., Caligari, P. D. S., Dale, M. F. D., Swan, G. E. L., & Mackay, G. R. (1988). The use of cross prediction methods in a practical potato breeding programme. *Theoretical and Applied Genetics*, *76*, 33–38. https://doi.org/10.1007/BF00288830

Brown, J., Caligari, P. D. S., Mackay, G. R., & Swan, G. E. L. (1987). The efficiency of visual selection in early generations of a potato breeding programme. *Annals of Applied Biology*, *110*, 357–363. https://doi.org/10.1111/j.1744-7348.1987.tb03271.x

European Cultivated Potato Database (ECPD). (2025). *European cultivated potato database*. https://www.europotato.org (Accessed on February 15, 2025)

Cagirgan, I. (1989). Studies on the determination of genotypic variation and its utilization through selection in barley mutant populations. Ege University, Institute of Science and Technology, Department of Field Crops. (PhD thesis). (in Turkish)

Gopal, J., Gaur, P. C., & Rana, M. S. (1992). Early generation selection for agronomic characters in a potato breeding programme. *Theoretical and Applied Genetics, 84*(5–6), 709–713. https://doi.org/10.1007/BF00227390

Falconer, D. S. (1964). Introduction to quantitative genetics. The Ronald Press Company. New York.

Kelly, J. K. (2008). Testing the rare-alleles model of quantitative variation by artificial selection. *Genetica*, *132*, 187–198. https://doi.org/10.1007/s10709-007-9162-5

Kelly, J. K. (2011). The breeder's equation. *Nature Education Knowledge, 4*(5), 5.

Konstantinova, S., & Fadeev, A. (2020). Evaluation of potato varieties as a source material for selection. *IOP Conference Series: Earth and Environmental Science*, *548*(7), 072001. https://doi.org/10.1088/1755-1315/548/7/072001

Lush, J. L. (1945). *Animal breeding plans* (3rd ed.). Iowa State Press.

Mullin, R., Blomquist, A. W., & Lauer, F. I. (1966). Effect of seed tuber size on first clonal generation yield of potatoes. *American Potato Journal*, *43*(11), 418–423. https://doi.org/10.1007/BF02859279

Ozturk, G., & Yildirim, Z. (2014). Heritability estimates of some quantitative traits in potatoes. *Turkish Journal of Field Crops, 19*(2), 262–267.

Ozturk, G., & Yildirim, Z. (2020). New potato breeding clones for regional testing in western Turkey. *Turkish Journal of Field Crops, 25*(2), 131–137. https://doi.org/10.17557/tjfc.831907

Webb, R., Wilson, D., Shumaker, J., Graves, B., Henninger, M., Watts, J., Frank, J., & Murphy, H. (1978). Atlantic: A new potato variety with high solids, good processing quality, and resistance to pests. *American Potato Journal*, *55*, 141–145. https://doi.org/10.1007/BF02854064

Yildirim, M. B. (1972). Plant breeding seminar. *Turkish Agricultural Researchers Association Publication*. (in Turkish)

Yildirim, M. B. (1980). Selection studies on wheat mutant populations. E.U.Z.F. Publication No: 427. Bornova/Izmir. (in Turkish)

Yildirim, M. B. (1981). Population genetics I (Publication No: 400). Ege University Faculty of Agriculture. (in Turkish)

Yildirim, M. B., & Ozturk, G. (2021). Quantitative genetics. *BizimAvrupa* Publishing Company. (in Turkish)

Yilmaz, Z. (2023). Clone selection based on normal distribution in the F_1 generation of Bettina × Nif potato cross (Master's thesis). Ege University, Institute of Science, Izmir. (in Turkish)