World Academy of Science, Engineering and Technology
International Journal of Agricultural and Biosystems Engineering
Vol:9, No:12, 2015

Determination of Some Agricultural Characters of Developed Pea (*Pisum sativum* L.) Lines

Ercan Ceyhan, Mehmet Ali Avci

***Abstract*—**This research was made during the 2015 growing periods in the trial filed of "Research Station for Department of Field Crops, Agricultural Faculty, Selcuk University" according to "Randomized Blocks Design" with 3 replications. Research material was the following pea lines; PS16, PS18, PS21, PS23, PS24, PS25, PS36, PS47, PS49, PS51, PS54, PS58, PS67, PS69, PS71, PS73, PS83, PS84, PS87 and PSKY and three cultivars and other 2 commercial varieties named as Bolero, Rondo and Ultrello. Some agronomical characteristics such as plant height (cm) number of pod per plant number of seed per pod number of seed per plant 100 seed weight (g) and seed yield (kg ha^{-1}) were determined. The highest seed yield was obtained 2727.0 kg ha^{-1} in the PS71 line and the lowest value was obtained 1238.0 kg ha^{-1} in the commercial variety of Bolero. Results of the research implicated that the new developed lines were superior compared with the control (commercial) varieties by means of most of the characteristics. Nevertheless, similar researches should be continued in different locations and years.

***Keywords*—**Agricultural characters, pea, *Pisum sativum*, seed yield.

I. Introduction

IT is an undeniable fact now that nutrients used as protein source are very important for human nutrition. Pea, is a one of leguminous plants, is a good vegetable protein source in terms of contain high ratio protein like 20-30 %, adequate carbonhydrates, rich in calcium, iron and phosphor specially and, in addition, have several vitamins [1]. When viewed from this aspect, pea, used as canned and frozen food industry intensely, is very important plant in order to meet people needed protein.

To determinate link directly between grain yield and yield components helps selection studies. Hence, when new variety is developed, to know effective features on yield provide timesaving, laborsaving and high increased chance of success. To this end, lot of researchers determine on link between grain yield and yield components on pea [2]-[6].

In order to increase yield which is obtained from unit area, varieties which has superior efficient, high quality, resistant to disease, pests must be improved, and these must be delivered to producer. In addition, cultural proceeds which will provide to reveal genetic potentials of these varieties must be put into practice. Cultural proceeds which are demanded by varieties determine by means of agronomic studies to be done. So as to pea varieties which has high yield take place in rotation uniquely as hoeing plant and legume in Konya region, cultivation techniques and particularly sowing density which differ from ecology to genotype must adjust optimal level.

Pea, is a high important plant for human nutrients firstly and a lot of subjects, should be increased as planting area and production of pea. For this purpose, it is very important that determination of the most suitable ecology and breeding techniques of pea breeding, improvement of quality, high yield, meet iner and outer market demands varieties and transportation seeds to producer. When it comes to climatic and soil requirements, pea, has property with regard to in nearly Turkey and large ecological areas in the world, is the temperate cimate plant and generally develop well in sandy-loam soil in cool climates. Due to, in the research, grain yield and some agriculture features of the plants in F_5 generation was examined.

E. Ceyhan, M. A. Avci are with the Department of Field Crops, Agricultural Faculty, Selcuk University, Konya, 42075 Turkey (corresponding author, phone: 090-332-2232856; fax: 090-332-2232856; e-mail: eceyhan@selcuk.edu.tr, mavci@selcuk.edu.tr).

II. Material And Method

The research was conducted during 2015 years in the trial field of "Research Station for Department of Field Crops, Agricultural Faculty, Selcuk University" in Konya-Turkey. Konya is located at 32o31 N` latitude and 37o52`E longitude with an altitude of 1020 m above the mean sea level.

Five cycles of pedigree selection were made and 3000 pea crosses from pea breeding program of Assoc. Prof. Dr. Ercan Ceyhan were selected from those promising lines based on seed yield and different agronomical traits. The plant materials which were used in this study consisted from twenty four pea lines (PS16, PS18, PS21, PS23, PS24, PS25, PS36, PS47, PS49, PS51, PS54, PS58, PS67, PS69, PS71, PS73, PS83, PS84, PS87 and PSKY and two cultivars (Bolero, Rondo and Ultrello) as controls.

The average meteorological data during vegetation period (April, May, June and July) as follows: 11.9 ^{0}C, 18.4 ^{0}C, 21.6 ^{0}C and 23.3 ^{0}C for average temperature, 6.2 mm, 47.3 mm, 8.8 mm and 0.8 mm for total rainfall and 58.1%, 45.9%, 36.3% and 34.0 % for relative humidity respectively.

The characteristics of soil follow as clay-loam structure, a normal level of organic matter (2.25%) in 0-30 cm depth and low level in 30-60 cm depth. Lime content was high (37.6%, 34.4%, respectively), alkali reaction (pH = 8.05 – 8.00), no salinity problem was seen in the soil. The available phosphorus (17.9 kg ha^{-1} – 13.4 kg ha^{-1}) and zinc (0.32 ppm – 0.34 ppm) levels were low. Low presence of these elements in the soil stems substantially from the high rate of lime. According to the soil analysis, rich content of available potassium (51.60 kg/da) and the level of iron (14.74 ppm – 8.74 ppm), copper (1.70 ppm – 1.74 ppm) and manganese (7.50 ppm – 5.76 ppm) were sufficient.

TABLE I
MEANS SQUARES OF INVESTIGATED CHARACTERISTICS IN THE PEA GENOTYPES

Source of Variance	SD	Plant Height	Pods per Plant
Blocks	4	814.1355	79.181
Genotype	9	1694.925**	325.211*
Error	36	757.460	76.347
Source of Variance	SD	Seeds per Pod	Seed per Plant
Blocks	4	2258.764	0.180
Genotype	9	2692.051*	2.188**
Error	36	1363.21	0.959
Source of Variance	SD	Seed Yield	100 Seed Weight
Blocks	4	9018.150	7.232
Genotype	9	4713.014	61.105**
Error	36	3914.810	22.825

*: p<0.05; **: p<0.01

The trial was conducted in "Randomized Complete Block Design" with 3 replications. For sowing was made by hand in a five-row plot with 3m long on 01 April 2015. The rows were spaced with 50 cm distance and plants were spaced every 5 cm inside a row. The fertilizer was applied 150 kg ha^{-1} DAP (Diammonium phosphate 18-46%). The experimental crops were irrigated three times (during flowering initiation and two times during pod filling time) during vegetation period. The hoeing was made for two times to weed and soil ventilation. The harvest was made by hand after the maturing and being yellow colored period of whole plants on plots.

The investigated characteristics in the research were as follows: plant height (cm) pod per plant (number), seed per pod (number), seed per plant (number), 100 seed weight (g), seed yield (kg ha^{-1}) respectively [2]-[4]. Analysis of variance and LSD test was made by using "JUMP" computer based statistical program.

III. RESULTS AND DISCUSSIONS

A. Plant Height

As investigation of Table I was appeared, the effects of genotypes on plant height were found important. The highest plant height was taken from genotype PS84 (126.67 cm), while Bolero showed the lowest (53.50 cm) plant height (Table II). Plant height is affected by environment and genotype in pea [3]-[6]. Related former researches was reported the plant height as between 40.87-53.48 cm by Öz and Karasu [7], 43.96-59.12 cm by Demirci and Unver [8]. On the other hand Ceyhan et al. [4] found the plant height in pea as 34.0 - 72.3 cm and also the finding of Ceyhan et al. [6] was 36.59 - 75.84 cm. This situation exposes plant height is affected by environment besides genotype characteristics.

B. Pod per Plant

The variation was significant at the $P < 0.05$ level between the genotypes for pod per plant (Table I). The highest value was taken from PS71 genotype (60.50 number), while PS87 showed the lowest (14.33 number) pod per plant. The other genotypes which were used in the research showed their values between these intervals (Table II). Number of pod per plant is affected by environment and quite effective on the yield [5], [6]. Previous findings on this characteristics were in between 18.3 - 38.3 [6], 12.34 - 23.99 [6] and 35.18-39.17 [9].

TABLE II
MEANS OF INVESTIGATED CHARACTERISTICS BY YEARS IN THE PEA GENOTYPES

Genotypes	Plant Height	Pods per Plant	Seeds per Plant
PS16	59.33 de	29.67 b-e	127.33 a-e
PS18	114.33 a-d	20.00 cde	103.33 b-f
PS21	104.33 a-e	17.67 de	98.33 b-f
PS23	65.00 cde	37.00 bc	119.00 b-f
PS24	71.50 be	26.33 b-e	87.00 def
PS25	77.67 a-e	25.33 b-e	94.33 b-f
PS36	102.67 a-e	30.00 b-e	92.67 c-f
PS47	73.00 a-e	33.00 b-e	94.00 b-f
PS49	88.00 a-e	28.00 b-e	104.33 b-f
PS51	101.08 a-e	21.33 cde	108.08 b-f
PS54	105.67 a-e	25.00 b-e	84.33 def
PS58	69.33 b-e	39.00 bc	129.67 a-e
PS67	65.00 c-e	28.00 b-e	88.67 def
PS69	121.00 abc	28.00 b-e	138.33 a-d
PS71	132.00 a	60.50 a	187.50 a
PS73	80.50 a-e	35.00 bcd	154.50 ab
PS83	60.67 de	32.33 b-e	121.00 b-f
PS84	126.67 ab	23.33 cde	88.33 def
PS87	56.67 de	14.33 e	77.67 e-f
Bolero	53.50 e	20.50 cde	72.50 e-f
PSKY	84.00 a-e	43.67 ab	151.33 abc
Rondo	70.00 b-e	20.50 cde	77.50 e-f
Ultrillo	88.50 a-e	14.50 e	66.50 f
Mean	85.67	28.39	107.23
Genotypes	Seeds per Pod	Seed Yield	100 Seed Weight
PS16	4.27 a-d	1709.7	19.77 f
PS18	5.30 abc	2048.0	28.77 a-f
PS21	5.63 ab	1683.3	23.97 b-f
PS23	3.27 cd	2700.0	32.53 a-d
PS24	3.33 cd	2244.0	36.53 a
PS25	3.67 a-d	2238.7	32.93 a-d
PS36	3.10 d	2006.0	30.47 a-e
PS47	2.87 d	2047.0	31.27 a-e
PS49	3.93 a-d	2003.7	28.70 a-f
PS51	4.87 a-d	1767.0	25.60 b-f
PS54	3.57 bcd	1577.7	27.13 a-f
PS58	3.23 cd	2125.0	24.60 b-f
PS67	3.20 cd	1898.0	30.73 a-e
PS69	4.97 a-d	2195.0	22.57 def
PS71	3.23 cd	2727.0	21.60 ef
PS73	4.40 a-d	2558.0	23.90 b-f
PS83	3.73 a-d	2389.3	27.83 a-f
PS84	4.13 a-d	2046.7	33.13 abc
PS87	5.73 a	1714.0	31.60 a-e
Bolero	3.50 bcd	1238.0	24.43 bf
PSKY	3.60 a-d	2559.7	23.43 c-f
Rondo	3.83 a-d	1586.7	29.23 a-f
Ultrillo	4.57 a-d	1580.0	33.97 ab
Mean	4.00	2027.9	28.03

Figures in the same line column a common letter are not significantly different.

C. Seed per Plant

Analysis of variance for number of seeds per plant among

genotypes found important (Table I). As investigation of Table II was appeared, the seed number per plant was varied from 72.50 (Bolero) to 187.50 (PS71) in genotypes. Avci and Ceyhan [10] reported that the more the seeds of plant in unit area increases, yield increases per hectare. Similar conclusions were also determined by Avci and Ceyhan [10].

D. Seed per Pod

According to the results of variance analysis for number of seeds per pod among genotypes found important statistically (Table I). The number of seeds per pod were changed between 2.87 (PS47) and 5.73 (PS87) among genotypes (Table II). Pea has a high positive correlation between seed yield and seed per pod and seed per plant [11]. For this reason, these characteristics are used as selection criteria [5], [6]. Some researchers stated 3.0 - 6.3 [5], 3.40-5.80 [12], 5.62-6.73 [13] and 5.08 - 7.67 [14] for number of seed per pod in pea genotypes. Similar results were also found in the present study [10].

E. Seed Yield

Analysis of variance for seed yield among genotypes found unimportant (Table I). As investigation of Table II was appeared, the seed yield that is the main object of the breeding works was the highest with 2727.0 kg ha^{-1} in the PS71 line and the lowest value was obtained in the commercial variety of Bolero (1238.0 kg ha^{-1}) (Table II). The pea lines of the PS71, PS23, PSKY, PS73, PS83 and PS24 were the main genotypes of the research. Seed yield differences of the genotypes occurred owing to genetic structure of the genotypes and climatic differences between the years [4], [16]. Related studies are as following Ceyhan et al. [6] 720 - 1440 kg ha^{-1}, Rickertsen [13] 408.0-1822.0 kg ha^{-1}, Alan and Geren [15] 1430.0-3490.0 kg ha^{-1}, McPhee and Muehlbauer [16] 1280 - 3090 kg ha^{-1} and Rasei et al. [17] 1000.5-2160.5 kg ha^{-1}. These findings are in accordance with the present study.

As it be in all plants higher seed yield is also the most important feature in pea. For the highest protein ratio of the plants is in the seeds [18]. Seed yield a quantitative character [3], [19] is a feature that is affected by genetic structure and environment - especially temperature [3], [4], [6]. Researchers Akçin [1] and Ceyhan et al. [3] stated that seed yield is negatively affected by high temperature and insufficient precipitation during the flowering period.

F. 100 Seed Weight

In the trial, according to the results of variance analysis among genotypes for 100 seed weight found statistically important (Table I). The weights were varied between 19.77 g (PS16) and 36.53 g (PS24) for 100 seeds (Table II). Thousand seed weight an important yield component is affected by environment conditions and also by the genetic structure of genotypes [6]. A positive correlation formed between 1000 seed weight and seed yield [14]. Data of recent studies showed the 1000 seed weight in pea as 99-194 g [3], 87.08 - 183.08 [6], 243.81-253.81 g [12] and 187.2-271.6 g [15]. Weight of 1000 seed in pea usually varies depending on genotypes and climatic factors.

IV. Conclusion

To done trials of varieties developed in pea breeding studies as in different local areas do in this study and to done selection to producer demands is suitable for us. Genotypes done selection were tried by taking into consideration in this study. According to conclusion of one-year study, the prominent pea lines PS71, PS23, PSKY, PS73, PS83 and PS24 that used in the research are promising genotypes due to higher seed yield than commercial varieties.

Acknowledgment

This study was supported by Selcuk University Scientific Research Projects (BAP) Coordinating Konya –Turkey.

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