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DETERMINATION OF FRUIT DETACHMENT FORCE OF SOME INDUSTRIAL PEPPER BREEDING LINES

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Abstract
Pepper production is found from the humid tropics, to the dry deserts, to the cool temperate climates. The ability of pepper to thrive under this range of climatic conditions has rendered it a common crop worldwide. USA, China, India and Turkey are major producer in the world. The production of pepper has done in two different ways as industrial and fresh consumption. Industrial production are sauce, canned food and powder form or red pepper flakes after drying. In industrial pepper cultivation for spice production, harvesting the fruits is time consuming and high cost requiring process. The pedicel is tightly attached with the calyx to the fruit pod in most pepper cultivar. For this reason fruit detachment force is an important for pepper breeding programs. In present study, it is aimed that determination of fruit detachment force of some breeding lines for breeding program. Total 145 pepper lines were used and fruit detachment force of pepper lines were observed as newton. As results of study, fruit detachment of pepper lines varied between 0.56-4.41 N. Variation is useful for pepper breeding programs with regard to fruit detachment force.

Keywords: breeding, fruit detachment force, Pepper.

1. INTRODUCTION

The production of pepper has done in two different ways as industrial and fresh consumption. Industrial production are sauce, canned food and powder form or red pepper flakes after drying. Dried peppers have the greatest importance among them. Turkey is 18 ranks with approximately 76.5% of the South, the Aegean region of 6% and 17.5% in the Mediterranean of 70,000 square meters in area with the production of 15,900 tons of red pepper then Bosnia and Herzegovina (Yalcin, 2008; FAO, 2018). Some of the main limiting factors at pepper cultivation are viruses, bacteria, nematodes and fungi etc. biotic factors that cause yield loss. Resistant cultivars are being developed and cultural practices are used to prevent the loss in production. Even molecular markers have been development linked to disease and pest resistant to improve resistant varieties are used to overcome the issues as soon as possible and disregarded. But harvest quality and post-harvest operations have been neglected at red pepper production apart from yield and disease resistance. Especially, measures to reduce the cost for manufacturing and processing can be advantageous in areas where in pepper production in Turkey. One of them is low fruit detachment to facilitate the harvest during harvest, to allow harvesting machine, especially at drying pepper, facilitate to drying and pull the handle. Breeding programs around the world began to be formed taking into account this feature. Tanks to fruit detachment force in red pepper, it won't needed to pull the handle during harvest and won't needed second labor costs. Harvested pepper will be transfer for driying directly

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and moisture and temperature of crop will decrease. Thus, formed of aflatoxin will be prevented because of it will be transfer as clean. Remain of fruit stem on fruit in pepper is disadvantages for formed of aflatokxin and labor costs before process. Detected prior to processing pepper fruit to remain on the handle workmanship is used to separate the handle next to the fruit during drying because of its disadvantage is the formation of aflatoxins. Smith (1951) stated that the deciduous character in *C. annuum* is inherited as a single dominant gene. Althought transfer of multiple gene-controlled characters to pepper breeding lines are difficult, transfer of a single dominant genes are uncomplicated. Especially, pepper breeders need pepper lines which has weak fruit detachment force for industrial pepper breeding programs. The objectives of this to determine fruit detachment force of some industrial pepper lines to use pepper breeding program.

2. MATERIALS AND METHODS

In present study, total 145 pepper genotypes were used. Peppper genotypes selected from dried pepper breeding program. 10 pepper fruits were harvested at red fruit ripening stage from pepper genotypes and fruit detachment force were measured using dinamometer as Newton(N). Also, some fruit features which fruit height (mm), fruit weidty (mm), fruit weight (g) and fruit thickness (mm) determined using same fruits of pepper genotypes.

3. RESULTS AND DISCUSSION

In this study, fruit detachment force and some fruit features which fruit height(mm), fruit weidty (mm), fruit weight(g) and fruit thickness(mm) determined using 145 pepper genotypes and results were showed at Table 1.

As obtained results, fruit detachment force of pepper genotypes varied 0.56-4.41 N. Fruit height varied 22.4-190 mm, fruit weidty varied 11.12-36.64 mm, fruit weight is between 3-47.9 g and fruit wall thickness varied 0.56-4.03 mm. Especially, important variation was obtained with regard to fruit detachment force (Figure 1).

Also, correlation were calculated between fruit detachment force and some fruit features which fruit height, fruit weidty, fruit weight and fruit thickness. As obtained results, correlation between fruit detachment force and fruit height was 0.26 (26%), between fruit weidty was 0.55, between fruit weight was 0.58 and between fruit wall tichness was 0.21.

Table 1. Fruit detachment force and fruit height (mm), fruit weidty (mm), fruit weight(g) and fruit thickness(mm) of 145 pepper genotypes

Genotype No	Fruit height (mm)	Fruit weidty (mm)	Fruit weight (g)	Fruit wall thickness(mm)	Fruit detachment force(N)
SK1	103.63	14.37	8.15	0.93	0.56
SK2	88.49	27.26	13.81	1.62	0.56
SK3	67.94	17.61	6	1.02	0.58
SK4	45.33	17.22	6.17	0.66	0.62
SK5	58.51	16.92	7.16	1.36	0.71
SK6	52.6	17.83	9.57	1.22	0.76
SK7	47.92	15.88	3	0.67	0.77
SK8	67.9	11.12	7.15	1.58	0.77
SK9	125.35	22.01	11.25	1.13	0.81
SK10	48.48	16.05	5.04	1.08	0.81

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SK11	64.65	12.4	3.74	1.17	0.86
SK12	110.58	18.34	13.08	1.63	0.88
SK13	51.87	14.23	6.3	1.82	0.88
SK14	108.93	20.15	10.94	1.44	0.9
SK15	107.83	20.88	12.57	1	0.9
SK16	22.64	20.28	10.83	1.23	0.91
SK17	121.85	21.2	13.62	1.85	0.96
SK18	123.3	17.89	17.51	1.36	0.98
SK19	106.43	14.08	6.58	0.8	1.01
SK20	35.5	12.39	3.72	0.85	1.01
SK21	76.81	18.68	10.33	0.8	1.04
SK22	120.88	19.66	10.72	1.17	1.04
SK23	83.98	14.67	7.17	0.98	1.06
SK24	33.4	16.4	3.18	1.02	1.06
SK25	117.49	19.37	24.38	1.44	1.07
SK26	76.24	12.44	5.51	0.9	1.1
SK27	113.07	16.94	10.14	1.12	1.11
SK28	121.13	23.67	13.46	1.92	1.12
SK29	101.32	15.59	8.53	1.14	1.13
SK30	69.27	12.1	3.71	0.62	1.14
SK31	100.85	15.36	8.2	1.94	1.14
SK32	101.47	20.2	14.52	0.61	1.14
SK33	73.5	13.64	5.41	0.75	1.15
SK34	118.82	18.82	11.81	1.76	1.15
SK35	81.15	15.88	8.45	1.21	1.15
SK36	120.37	15.2	8.86	1.37	1.16
SK37	123.99	20.09	14.95	1.05	1.17
SK38	101.65	17.68	15	1.13	1.19
SK39	119.24	25.09	15.34	0.91	1.19
SK40	112.04	20.29	12.31	2.37	1.2
SK41	111.3	21.54	12.88	1.36	1.2
SK42	102.91	19.71	11.75	3.32	1.2
SK43	52.27	19.46	5.73	1.4	1.2
SK44	104.42	36.64	19.58	1.54	1.22
SK45	108.52	13.69	6.22	1.02	1.22
SK46	45.01	20.46	7.6	1.57	1.24
SK47	115.08	19.7	12.85	1.11	1.24
SK48	120.1	24.72	16.08	0.99	1.26
SK49	124.1	22.61	13.77	0.98	1.27

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SK50	72.25	13.76	5.88	1.19	1.28
SK51	118.08	18.7	11.65	1.31	1.29
SK52	101.91	19.16	11.73	1.65	1.3
SK53	129.7	26.37	18.33	1.1	1.3
SK54	71.87	14.68	7.44	1.33	1.3
SK55	102.56	22.37	19.07	1.17	1.3
SK56	106.56	14.5	11.85	1.1	1.31
SK57	112.99	15.7	8.6	1.06	2.2
SK58	100.59	16.01	10.7	0.88	2.22
SK59	66.24	21.01	10.79	1.11	2.22
SK60	120.5	16.76	11.98	1.31	2.23
SK61	118.51	25.97	13.05	1.29	2.25
SK62	119.62	28.11	20.96	1.56	2.25
SK63	23.29	32.44	20.53	1.75	2.26
SK64	105.87	18.97	10.85	2.3	2.26
SK65	107.07	17.6	9.79	1.15	2.26
SK66	118.6	20.1	11.72	1.16	2.29
SK67	113.62	19.54	11.19	1.1	2.29
SK68	121.06	16.52	12.24	0.56	2.31
SK69	107.43	15.45	11.86	1.43	2.31
SK70	103.83	28.12	17.45	1.36	2.31
SK71	124.19	18.23	8.8	1.15	2.31
SK72	57.96	19.6	10.07	1.36	2.34
SK73	60.1	14.35	4.76	0.95	2.35
SK74	128.8	20.44	18.83	1.25	2.36
SK75	98.36	28.04	13.08	1.12	2.36
SK76	103.73	25.3	16.48	1.34	2.37
SK77	86.02	19.96	13.55	1.38	2.38
SK78	96.02	14.33	7.19	1.24	2.38
SK79	108.03	26.27	26.75	1.29	2.38
SK80	115.4	21.49	15.13	1.62	2.41
SK81	102.51	17.79	12.26	1.12	2.42
SK82	89.93	18.55	10.63	1.13	2.48
SK83	69.53	28.98	28.79	1.88	2.49
SK84	91.47	20.25	11.69	1.16	2.5
SK85	124.43	17.14	12.9	1.13	2.5
SK86	97.22	27.09	12.71	1.18	2.51
SK87	111.7	29.51	16.14	1.42	2.51
SK88	92.85	22.87	11.19	0.81	2.55

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SK89	112.66	21.76	12.43	1.23	2.57
SK90	87.48	22.6	15.8	0.91	2.58
SK91	120.11	19.33	14.14	1.67	2.58
SK92	112.45	19.87	14.26	1.38	2.66
SK93	107.33	29	15.83	1.37	2.7
SK94	113.43	28.62	16.34	1.44	2.7
SK95	94.5	26.03	13.72	1.28	2.7
SK96	104.78	18.96	13.96	1.3	2.74
SK97	106.45	22.08	13.68	0.86	2.75
SK98	105.38	26.32	17.02	1.09	2.77
SK99	95.69	17.16	9.68	0.73	2.78
SK100	130.28	21.63	12.44	1.11	2.8
SK101	190	24.37	25.54	1.8	2.83
SK102	111.13	22.22	16.87	2.02	2.84
SK103	99.92	30.45	17.09	0.93	2.84
SK104	124.57	16.37	11.74	0.71	2.86
SK105	123.69	21.76	16.46	1.25	2.87
SK106	129.44	20.97	15.3	1.14	2.87
SK107	86	17.75	10.61	0.92	2.87
SK108	125.17	20.67	16.87	0.82	2.87
SK109	99.18	26.24	17.15	1.76	2.88
SK110	110.41	18.74	11.1	1.18	2.93
SK111	102.09	12.38	5.98	0.91	2.95
SK112	98.27	34.5	28.71	1.57	2.98
SK113	126.65	18.51	13.12	1.24	2.99
SK114	114.63	25.15	18.07	1.41	3.01
SK115	93.95	25.33	16.09	1.09	3.02
SK116	102.62	30.02	27.39	2.36	3.04
SK117	150.65	20.19	26.78	1.78	3.1
SK118	114.31	26.43	16.51	1.22	3.13
SK119	81.05	25.5	13.16	1.35	3.13
SK120	118.18	21.47	13.29	1.15	3.14
SK121	126.95	19.22	12.91	1.06	3.17
SK122	102.72	21.48	17.23	1.73	3.17
SK123	97.13	28.29	16.49	0.93	3.18
SK124	105.01	25.89	19.21	1.15	3.2
SK125	101.02	21.96	16.88	1.33	3.24
SK126	87.7	30.36	23.99	1.37	3.25
SK127	86.85	32.06	22.16	4.03	3.26

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SK128	101.3	23.79	17.43	1.16	3.27
SK129	109.1	12.58	9.06	2.34	3.29
SK130	98.56	22.8	15.14	0.97	3.35
SK131	110.68	32.96	20.6	1.25	3.45
SK132	94.22	24.41	15.45	1.65	3.46
SK133	120.77	29.82	20.42	1.15	3.49
SK134	116.37	27.31	18.08	1.22	3.51
SK135	96.26	31.12	23.66	1.34	3.53
SK136	85.78	15.84	10.29	1.44	3.65
SK137	93.09	26.13	22.77	1.23	3.7
SK138	93.1	29.32	16.31	1.8	3.81
SK139	172	26.01	47.9	2.25	3.9
SK140	114.28	30.94	26.5	1.36	3.94
SK141	90.73	34.83	27.42	2.33	3.95
SK142	38	26.34	18.47	3.74	3.96
SK143	104.9	33.16	20.87	1.11	4.01
SK144	88.61	28.36	18.6	1.67	4.28
SK145	97.29	33.9	24.1	1.36	4.41
Max.	**190**	**36.64**	**47.9**	**4.03**	**4.41**
Min.	**22.64**	**11.12**	**3**	**0.56**	**0.56**
Mean	**99.64**	**21.49**	**14.10**	**1.34**	**2.17**

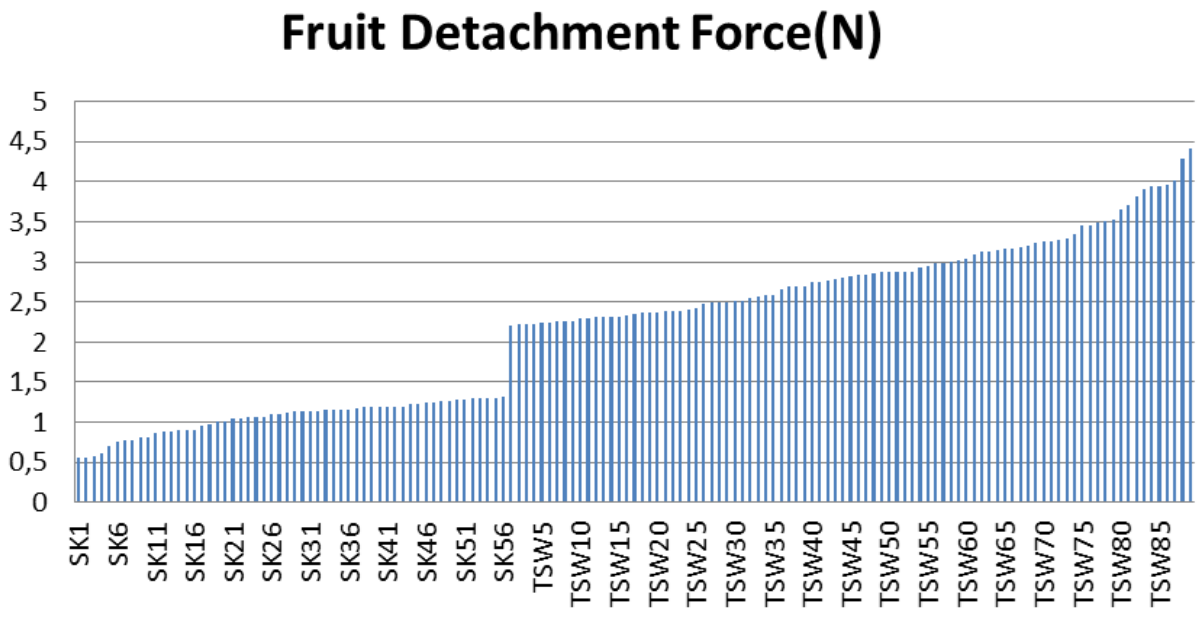

Figure 1. Distribution of fruit detachment force of pepper genotypes

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Smith. (1951) conducted a study to determine the inheritance of this character and to incorporate it into varieties suitable for commercial use. Chili Piquin was crossed with the non-deciduous Mexican Chili variety. The results show that the deciduous character in *C. annuurn* is inherited as a single dominant gene.

Limited evidence indicate that the deciduous character is dominant in several other species of *Capsicum* which are rarely seen in this country. But in the following crosses involving both allels. *C. Frutescens* x *C. frutescens*-Tabasco x Ac.9024. *C. frutescens* x *C. annuum*-Tabasco x Long Red Cayenne. *C. frutescens* x *C. pendulum*-Tabasco x Ac. 911-and *C. chacoense* x *C. annuum* x Long Red Cayenne-all crossbreds of the first generation were deciduous. All these other species are very difficult to hybridize with the cultivated pepper. so that Chili Piquin and the other wild forms closely related to it remain the best source of the deciduous gene. The soft flesh and deciduous fruit of pepper (*Capsicum* spp.) originated from the wild *C. frutescens* BG 2816 accession is a complete dominant trait controlled by the S gene (Rao and Paran. 2003).

Pepper genotypes which used in peresent study were obtained *C. annuum* X *C. frutescens* crossing population which used three backcross and selfed seven times. Some pepper genotypes which used as material in this study have weak fruit detachment force because of *C. annuum* X *C. frutescens* crossing population.

As conclusion weak fruit detachment force is important for industrial pepper breeding programs for easy harvest. Present pepper materials can use for industrial pepper breeding

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