HYBRID VIGOR OF CUCUMBER HYBRIDS DEVELOPED LOCALLY WHICH SUITABLE FOR OPEN FIELD CULTIVATION

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ABSTRACT

This experiment was carried out during two seasons; the first season 2016 included the planting of cucumber seeds from different global origins, which symbolized P1 and P2-P10 in a plastic house with (506 m^2) area, at Yusufiya – Baghdad to produce hybrids. During Spring season 2017 the genotypes seeds were planted (10 parents and 27 single cross hybrids with codes F1 and F2-F27 and three common commercial control hybrids with codes C1, C2 and C3) according RCBD design with three replicates, The genotype P5 was superior in the branches number per plant (9.67) and number of leaves per plant (220.33) as well as in total yield of experimental unit 18.03 kg, The hybrid F17 (P5×P9) took lowest number of days number until first female flower appearance (34.00 days) and number of days until first harvest (37.67 days), as well as it produce the highest fruit weight 178.747 gm, the most of hybrids had significant heterosis, the hybrid F23 had the highest positive hybrid vigor in number of leaves per plant (73.03%), the hybrids F4, F17 and F19 had negative heterosis in number of days until first female flower appearance, eight hybrids had positive hybrid vigor in weight of fruit but 16 hybrids had heterosis in experimental unit yield and the highest value obtained from F27 67.77%, while in control hybrid vigor, 15 hybrids had the superiority in numbers of branches so the highest value obtained from F3 53.96%, also it had the highest value of control hybrid vigor in number of leaves per plant 93.21%, the hybrid F27 had significant control hybrid vigor in experimental unit yield 66.79%.

Key Word: *Cucumis sativus* L. , direct crosses, heterobeltiosis, gene action, yield.
Part of Ph.D. Dissertation of the second author

قوة الهجين لهجن خيار مستنبطة محلياً مناسبة للزراعة المكشوفة

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المستخلص

نفذت التجربة في موسمين، تضمن الموسم الاول 2016 زراعة بذور سلالات من الخيار من مناشئ عالمية مختلفة رمز لها P1 و P2 – P10 في بيت بلاستيكي (506م^2) في منطقة اليوسفية وعند التزهير اجريت التهجينات بينها وتم الحصول على بذور 27 هجين ، في الموسم الثاني (الموسم الربيعي 2017) زرعت بذور التراكيب الوراثية [10 اباء و 27 هجين فردي رمز لها بالرموز F1 و F2–F27 و ثلاثة هجن قياس رمز لها C1 و C2 و C3] وفق تصميم القطاعات الكاملة المعشاة RCBD وبثلاث مكررات ، تفوقت السلالة P5 في عدد الافرع .نبات$^{-1}$ (9.67 فرع) وعدد الاوراق.نبات$^{-1}$ (220.33 ورقة) فضلاً عن تفوقها في حاصل الوحدة التجريبية بوزن بلغ 18.03 كغم، بكر الهجين F17 (P5×P9) في اقل عدد من الايام حتى ظهور اول زهرة مؤنثة (34.00 يوماً) وفي عدد الايام حتى اول جنية (37.67 يوماً) فضلاً عن اعطائه لاعلى وزن ثمرة بلغ 178.747 غم، اظهرت اغلب الهجن غزارة هجينية مرغوبة، إذ أعطى الهجين F23 قوة هجين موجبة معنوية في عدد الاوراق بلغت 73.03% فضلاً عن اعطاء الهجن F4 وF17 وF19 غزارة هجينية سالبة في عدد الايام حتى ظهور اول زهرة مؤنثة ، اعطت ثمانية هجن مستنبطة قوة هجين موجبة في وزن الثمرة فضلاً عن اعطاء ستة عشرة هجيناً غزارة هجينية في حاصل الوحدة التجريبية كانت اعلاها للهجين F27 بلغت 67.77%، أما في قوة الهجين القياسية فتفوق خمسة عشر هجيناً في عدد الافرع إذ كانت اعلى قيمة عند الهجين F3 (53.96%) فضلاً عن اعطائه اعلى قيمة لقوة الهجين القياسية في عدد الاوراق (93.21%) اعطى الهجين F27 قوة هجين قياسية معنوية بلغت 66.79% في حاصل الوحدة التجريبية.

الكلمات المفتاحية: *Cucumis sativus* L.، تهجينات مباشرة، غزارة هجينية، فعل الجين، الحاصل
البحث مستل من اطروحة دكتوراة للباحث الثاني

***Received:11/10/2017, Accepted:30/1/2018**

INTRODUCTION

The cucumber *Cucumis sativus* L. belongs to the Cucurbitacea family and it is one of the very important crop, due to the increasing demand by the producers and consumers, for its economic and consumer importance, this encouraged the farmers to grow this crop and increase the production and improve the quality of fruits using modern techniques and to benefit from various sciences in the development of this crop production, one of the most important sciences is the plant breeding, and hybrids production which characterized by vigor growth, homogeneity, high production, ability to absorb nutrients and best quality fruits (7). The hybrid vigor is one of the most important genetic phenomena that are of great importance in plant breeding, as it is a major source in increasing and improving the production and other economic characteristics of the crops, (17). In order to obtain a positive hybrid vigor, there is a need for hybridization between inbreed lines with highest general and specific combining ability (3), The production of highest yield as well as, better than the best parent depends to the over dominance gene action (8), Different studies were examined the phenomenon of hybrid vigor in the Cucurbitacea family, to produce early growth, flowering, yield and fruit quality of the cucumber (1, 5,12,15 ,18,19, 25). The objective of this study production single cross hybrids which, characterized better than the best parents.

MATERIALS AND METHODS

The seeds of ten inbred lines of cucumber were cultivated: Beth Alpha (Occupied Palestine), 205, 206 (Taiwan), Marketmore76 (America), 44 (Russia), Nindin, Esvier (Netherlands), Green Titan, Smart Green (Korea) and Xin Huan Gua (China) which were named by the symbols (P1, P2, P3, P4, P5, P6, P7, P8, P9 and P10) respectively in a plastic house (506 m^2) in the Yusufiya south of Baghdad during the fall season 2016 on 15/9/2016 in the terraces with width 0.8 m and length of 56 m inside plastic house which include five terraces, every terrace included two lines, the distance between the plants 0.4 m. Varietal trait for 10 parents, 27 crosses and 3 controls (Falcato from Nickreson company, Najem's and Ghazeer from Seminis company which named C1, C2 and C3 respectively), were planted in sheets of cork include 209 holes, in one of the nurseries in of the Agriculture Collage, the seedlings were transplanting to the field experiment at the College of Agriculture - University of Baghdad - Jadriya on 8/3/2017. The seedlings were planted on both sides of the terraces, the distance between the terraces and the other 1.75 m and between plant and the other 0.4 m and with ten plants in each of experimental unit using Randomized Complete Block Design with three replicates. The irrigation, weeds and diseases control were carried out according to needs. The results were analysis using analysis of variance and the means were compared using LSD. 5% (4) . The hybrid vigor was calculated according to the best parents, except, early of maturity and fruit diameter compared to the lowest parents, and using the standard error to compare of the hybrid vigor, the control hybrid vigor was calculated compared with best of control hybrids for most controls and for the least control hybrids in the early maturity and fruit diameter and using the standard error to determine the significance of the control hybrid vigor.

RESULTS AND DISCUSSION

The results in Table 1 shows significant differences among the lines in vegetative growth traits and early maturity, P5 was superior in number of branches per plant and number of leaves per plant (9.67 branch and 220.33 leaf) respectively, the lines P5 and P10 had least number of days until first female flower appearance compared with other lines which flowered 34.00 days, while the lowest number of days to first harvest obtained from P5 and P10 37.33 days. Significant differences were found among the hybrids in vegetative growth characters and early maturity because of differences among its parents. The hybrid F3 (P2 x P5) produce the highest number of branches per plant (6.67 branch), which didn't differed significantly from 6 hybrids, but it was differed significantly from other hybrids, that produce the highest number of leaves per plant (6) , as well as it didn't differed significantly from the hybrid F23 (P9 x P2), while hybrid F17 (P5 x P7) was to take the lowest number of days to first female flower

appearance compared with the most other hybrids (34.00 days). After cultivation, in number of days until first harvest, the hybrid F17 to take 37.67 days. The results in Table 1 shows that several hybrids F3, F7, F8, F14, F15, F17and F23 were superior in number of branches plant^{-1} when , compared to the control hybrids and 7 hybrids F1, F3, F4, F15, F16, F23 and F24 in number of leaves plant^{-1}, while the number of days until first female flower appearance, 14 hybrids were superior in this indicator, while in early maturation until first harvest, 21 hybrids had significant difference compared to all control hybrids, this results in agreement with results of Nehe et al (16) in cucumber plant. The results in Table 2 confirm that there is significant differences among the parents, the parent P2 is superior in the fruit weight (171.43 gm) than the other parents, while in the experimental unit, the parent P5 was significantly higher than the other parents , with (18.03 kg), as well as the length of the fruit, the results shows significant differences among the genotypes, the parents P8, P9 and P10 were significantly higher than most of the parents with values 26.67, 25.83 and 27.67 cm, respectively. Also Table 2 shows that the P8 produced a minimum fruit diameter 2.33 cm, the differences among parents led to improve the characters of the yield and its components of the developed hybrid, the hybrid F17 had the highest fruit weight (178.747 gm) compared to most of developed hybrids. A significant differences were found among hybrid fruit length, the hybrid F27 produce 21.90 kg. The hybrids F5 and F6 were also distinguished in a length of fruit which had 26.50 and 29.67 cm, respectively compared to most of hybrids, the F25 hybrid produce the lowest value of fruit diameter 2.33 cm compared to most of the hybrids, this results in agreement with the results of other researchers (11) in the cucumber plant. Significant differences were found between the developed and control hybrids, it is found that there is superiority of four hybrids in the fruit weight and the superiority of most of the hybrids compared to the controls in the yield of experimental unit, There was superiority of some of hybrids compared to the control hybrids in the fruit length , 14th hybrids were superior in the fruit length compared to all control hybrids, there was distinguished of the F25 hybrid compared to the hybrids C2 and C3 in the fruit diameter which produce the least fruit diameter. The results in Table 3 shows that there is significant positive heterosis of F5, F7, F23, F24, F26 and F27 in the number of branches per plant, while in the number of leaves per plant, there was significant superiority of hybrids F1, F23 and F24 which had 14.31%, 73.03% and 14.23% respectively, as well as in the number of days until the first female flower appearance, the hybrids F4, F17 and F19 had a significant negative hybrid vigor, while in the number of days until the first harvest, the hybrid F1 had a significant negative hybrid vigor (-4.07%),F19 had (-2.53%) and hybrid F20 (-3.37%). The results in Table 4 shows that there is significant positive hybrid vigor for the several hybrids in the yield and its components of the developed hybrids of the cucumber, it was shows that the fruit weight was significantly, superiority with positive hybrid vigor, the hybrids F15, F17, F18, F21, F22 , F25, F26 and F27 shows positive and significant hybrid vigor in the yield, four of them showed a hybrid vigor more than 50%, like F27 (69.77%), F18 (56.48%), F21 (53.49%) and F25 (51.94%), While, the hybrids F2, F5, F6, F9, F14, F24, F26 and F27 shows positive hybrid vigor in fruit length by 2.74%, 2.59%, 7.22%, 5.87%, 2.89%, and 3.24% , 5.17% and 6.01%, respectively. Ten hybrids had negative hybrid vigor in the fruit diameter, the hybrid F2 (P2 × P3) had the higher negative hybrid vigor (-26.04%), this results in agreement with the results of other researchers (2, 6, 10, 14) in the squash plant. The results in the Table 5 shows that there are a significant hybrid vigor of F_1 when compared to the best of the control hybrids in vegetative growth and the lowest control hybrids in the early maturation, fifteen F_1 hybrids shows significant superiority compared to the highest control hybrids in the number of branches per plant, the highest value of the hybrid vigor obtained from the hybrid F3 (53.96%) in the number of branches plant^{-1}, while in the number of leaves plant^{-1}, it is revealed a significant hybrid vigor of nine developed hybrids compared to highest control hybrids and the highest value obtained from

the hybrid F3 (93.21) , the hybrid F17 also had the highest negative hybrid vigor (-9.74%) in the number of days until the first female flower appearance and the number of days until the first harvest obtained from the hybrid F17 (-9.61%), this results in agreement with results of Sharma (20) in cucumber plant. The results of Table 6 shows a positive hybrid vigor in the yield and its components when compared to the best control hybrids in the weight of the fruit, yield, weight and the fruit length when compare to the lowest control hybrids in the fruit diameter, nine developed hybrids had a significant hybrid vigor in fruit weight, the hybrid F17 had the highest value of the control hybrid vigor by 32.49%, while the most of the control hybrid had a significant control hybrid vigor compared to the highest of the control hybrid in experimental unit yield, the hybrid F27 had the highest hybrid vigor in the yield by (66.79), Also find it was revealed a control hybrid vigor in the seventeen developed hybrids in the fruit length, the hybrid F27 the highest control hybrid vigor (57.11%) compared to the highest control hybrids, but in the fruit diameter the hybrids F2 (P2 × P3) and F25 (P9 × P6) had a negative hybrid vigor compared to lowest control hybrids was -10.01% and -11.28%, respectively, this results in agreement with results of Singh et al (23) in cucumber plant. All the positive values of the hybrid vigor were under influence of over dominance gene action that increase vegetative growth traits, and yield and its components, this results agreement with results of (9 , 21 , 22 , 24) in the cucumber plant. It can be conclude from the results of this study there were significant differences among the inbred lines and there single cross hybrids in several plant traits , especially the hybrid F17 (P5 × P9) in fruit weight and early characters also it was bettered the control hybrids , while the hybrid F27 (P9 × P10) produced highest yield when compared to the other single cross hybrids and control hybrids.

Table 1. Vegetation growth and early traits for parents, hybrids and control for spring 2017

Characters / Genotype	Number of branches Plant^{-1}	Number of leaves plant^{-1}	Number of days to first female blossom (day)	Number of days to first harvest (day)
P1	5.33	96.67	38.33	41.33
P2	2.33	84.33	38.00	41.00
P3	2.33	80.00	38.00	41.00
P4	4.33	84.67	38.33	41.33
P5	9.67	220.33	34.33	37.33
P6	5.33	134.00	36.67	39.67
P7	4.33	75.00	36.00	39.00
P8	2.33	66.00	36.67	39.67
P9	3.33	89.00	35.33	38.33
P10	2.33	70.00	34.33	37.33
(P2×P1) F1	5.33	110.50	38.33	39.33
(P2×P3) F2	2.33	65.50	39.00	41.00
(P2×P5) F3	6.67	161.00	35.33	39.67
(P2×P6) F4	5.00	137.00	36.00	40.00
(P2×P9) F5	4.67	70.00	35.67	38.67
(P2×P10) F6	2.33	68.33	35.33	39.33
(P3×P1) F7	6.00	77.33	39.33	42.00
(P3×P5) F8	5.67	97.33	35.00	38.00
(P3×P6) F9	4.33	61.00	37.00	40.67
(P3×P9) F10	3.33	91.00	35.67	41.33
(P3×P10) F11	2.33	48.33	37.33	39.00
(P5×P2) F12	4.33	61.33	36.00	40.00
(P5×P3) F13	3.67	83.00	35.33	38.33
(P5×P4) F14	6.33	82.67	36.33	39.33
(P5×P7) F15	6.00	104.67	35.00	38.00
(P5×P8) F16	5.00	144.00	35.67	38.67
(P5×P9) F17	5.67	73.00	34.00	37.67
(P6×P1) F18	4.33	72.50	38.67	39.67
(P6×P2) F19	4.67	65.33	36.00	38.67
(P6×P3) F20	5.00	73.67	38.33	38.33
(P6×P9) F21	3.33	64.67	36.33	39.33
(P9×P1) F22	3.00	60.33	36.00	39.00
(P9×P2) F23	6.33	154.00	36.67	38.67
(P9×P3) F24	4.33	101.67	36.00	39.00
(P9×P6) F25	4.67	75.33	36.00	39.00
(P9×P7) F26	5.00	70.33	36.67	39.67
(P9×P10) F27	4.00	70.00	35.67	39.67
C1	2.33	54.00	37.67	43.00
C2	3.33	50.00	38.00	41.67
C3	4.33	83.33	39.33	44.67
L.S.D	1.21	14.26	1.50	1.82

Table 2. Yield traits and its components for parents, hybrids and the control for spring 2017

Characters / Genotype	Fruit Weight (gm)	Yield of experimental unit (kg)	Fruit Length (cm)	Fruit Diameter (cm)
P1	102.71	8.83	16.67	3.97
P2	171.43	13.72	24.17	3.20
P3	154.75	14.33	22.67	3.85
P4	149.02	10.84	17.17	2.83
P5	112.94	18.03	15.67	4.17
P6	111.70	11.00	19.00	2.83
P7	114.87	10.04	22.50	2.75
P8	146.72	13.80	26.67	2.33
P9	125.39	12.89	25.83	3.37
P10	122.25	11.37	27.67	2.73
(P2×P1) F1	134.34	13.93	18.33	3.13
(P2×P3) F2	173.26	15.70	24.83	2.37
(P2×P5) F3	173.84	16.43	20.83	3.23
(P2×P6) F4	170.88	17.07	21.83	3.13
(P2×P9) F5	139.18	14.73	26.50	2.87
(P2×P10) F6	157.56	16.77	29.67	3.23
(P3×P1) F7	149.61	17.79	22.33	3.43
(P3×P5) F8	148.98	19.53	21.50	3.35
(P3×P6) F9	148.85	14.88	24.00	3.13
(P3×P9) F10	140.57	18.20	23.67	2.95
(P3×P10) F11	141.11	14.87	25.67	3.25
(P5×P2) F12	129.15	12.75	19.17	3.55
(P5×P3) F13	136.12	17.31	19.77	3.33
(P5×P4) F14	117.92	11.86	17.67	3.40
(P5×P7) F15	148.08	17.37	18.08	3.13
(P5×P8) F16	146.21	18.17	18.83	3.33
(P5×P9) F17	178.75	19.27	18.50	3.03
(P6×P1) F18	135.43	17.21	17.42	3.23
(P6×P2) F19	148.00	14.07	17.67	3.10
(P6×P3) F20	151.31	15.60	18.67	2.83
(P6×P9) F21	146.83	19.80	18.17	3.13
(P9×P1) F22	135.73	16.66	20.17	3.13
(P9×P2) F23	143.76	14.98	23.67	2.83
(P9×P3) F24	151.02	14.58	26.67	3.33
(P9×P6) F25	137.17	19.60	24.00	2.33
(P9×P7) F26	137.76	17.38	27.17	2.83
(P9×P10) F27	147.21	21.90	29.33	2.83
C1	127.76	12.82	16.67	3.53
C2	146.26	13.13	15.67	2.63
C3	141.18	12.44	18.67	2.83
L.S.D	36.07	1.17	2.16	0.31

Table 3. Heterosis (%) for cucumber hybrids obtained from direct crossings measured to the best parent in vegetation growth and earliness for spring 2017

Characters / Genotype	Number of branches plant^{-1}	Number of leaves plant^{-1}	Number of days to first female blossom	Number of days to first harvest
(P2×P1) F1	0.06	14.31	0.88	-4.07
(P2×P3) F2	0.14	-22.33	2.63	0.00
(P2×P5) F3	-31.06	-26.93	2.92	6.26
(P2×P6) F4	-6.19	2.24	-1.83	0.83
(P2×P9) F5	40.14	-21.35	0.95	0.88
(P2×P10) F6	0.14	-18.65	2.92	5.37
(P3×P1) F7	12.57	-20.00	3.51	2.44
(P3×P5) F8	-41.40	-55.82	1.95	1.79
(P3×P6) F9	-18.70	-54.48	0.90	2.51
(P3×P9) F10	0.10	2.25	0.95	7.84
(P3×P10) F11	0.14	-39.58	8.75	4.47
(P5×P2) F12	-55.19	-72.12	4.86	7.15
(P5×P3) F13	-62.08	-62.27	2.92	2.69
(P5×P4) F14	-34.51	-62.42	5.84	5.37
(P5×P7) F15	-37.95	-52.42	1.95	1.79
(P5×P8) F16	-48.29	-34.55	3.89	3.58
(P5×P9) F17	-41.40	-66.82	-0.96	0.90
(P6×P1) F18	-18.70	-45.90	5.44	-0.01
(P6×P2) F19	-12.45	-51.24	-1.83	-2.53
(P6×P3) F20	-6.19	-45.02	4.54	-3.37
(P6×P9) F21	-37.46	-51.74	2.84	2.62
(P9×P1) F22	-43.71	-37.59	1.90	1.75
(P9×P2) F23	90.19	73.03	3.78	0.88
(P9×P3) F24	30.13	14.23	1.90	1.75
(P9×P6) F25	-12.45	-43.78	1.90	1.75
(P9×P7) F26	15.47	-20.97	3.78	3.49
(P9×P10) F27	20.12	-21.35	3.89	6.26
S.E	6.41	6.07	0.44	0.57

Table 4. Heterosis % for cucumber hybrids obtained via direct crossings and compared to the best parent in several traits crop for spring 2017

Characters / Genotype	Fruit Weight	Yield of experimental unit	Fruit Length	Fruit Diameter
(P2×P1) F1	-21.63	1.69	-24.15	-2.08
(P2×P3) F2	1.07	9.79	2.74	-26.04
(P2×P5) F3	1.41	-8.70	-13.80	1.04
(P2×P6) F4	-0.32	24.57	-9.67	10.72
(P2×P9) F5	-18.81	7.51	2.59	-10.42
(P2×P10) F6	-8.09	22.38	7.22	18.44
(P3×P1) F7	-3.32	24.38	-1.49	-10.82
(P3×P5) F8	-3.73	8.48	-5.16	-12.99
(P3×P6) F9	-3.82	4.08	5.87	10.72
(P3×P9) F10	-9.16	27.27	-8.38	-12.56
(P3×P10) F11	-8.81	4.00	-7.24	19.17
(P5×P2) F12	-24.66	-29.16	-20.70	10.94
(P5×P3) F13	-11.86	-3.81	-12.81	-13.42
(P5×P4) F14	-20.87	-34.09	2.89	20.26
(P5×P7) F15	28.91	-3.52	-19.63	13.94
(P5×P8) F16	-0.34	0.96	-29.38	43.06
(P5×P9) F17	42.55	7.04	-28.38	-9.99
(P6×P1) F18	21.24	56.48	-8.33	14.25
(P6×P2) F19	-13.67	2.68	-26.91	9.54
(P6×P3) F20	-2.22	9.09	-17.66	0.12
(P6×P9) F21	17.10	53.49	-29.67	10.72
(P9×P1) F22	8.25	29.11	-21.93	-7.02
(P9×P2) F23	-16.14	16.15	-8.38	-11.46
(P9×P3) F24	-2.41	1.98	3.24	-1.09
(P9×P6) F25	9.40	51.94	-7.08	-17.55
(P9×P7) F26	9.86	34.75	5.17	3.03
(P9×P10) F27	17.40	69.77	6.01	3.79
S.E	3.08	4.67	2.34	2.88

Table 5. Heterosis (%) for cucumber hybrids obtained by direct crossing in vegetation growth traits (compared to the highest control hybrids) and earliness growth (compared to the lowest control hybrids)

Characters / Genotype	Number of branches plant^{-1}	Number of leaves plant^{-1}	Number of days to first female blossom	Number of days to the first harvest
(P2×P1) F1	23.17	32.61	1.76	-5.61
(P2×P3) F2	-46.11	-21.40	3.53	-1.61
(P2×P5) F3	53.96	93.21	-6.20	-4.81
(P2×P6) F4	15.47	64.41	-4.43	-4.01
(P2×P9) F5	7.78	-16.00	-5.32	-7.21
(P2×P10) F6	-46.11	-18.00	-6.20	-5.61
(P3×P1) F7	38.57	-7.20	4.42	0.79
(P3×P5) F8	30.87	16.80	-7.09	-8.81
(P3×P6) F9	0.08	-26.80	-1.78	-2.41
(P3×P9) F10	-23.02	9.20	-5.32	-0.81
(P3×P10) F11	-46.11	-42.00	-0.89	-6.41
(P5×P2) F12	0.08	-26.40	-4.43	-4.01
(P5×P3) F13	-15.32	-0.40	-6.20	-8.01
(P5×P4) F14	46.27	-0.80	-3.55	-5.61
(P5×P7) F15	38.57	25.61	-7.09	-8.81
(P5×P8) F16	15.47	72.81	-5.32	-7.21
(P5×P9) F17	30.87	-12.40	-9.74	-9.61
(P6×P1) F18	0.08	-13.00	2.65	-4.81
(P6×P2) F19	7.78	-21.60	-4.43	-7.21
(P6×P3) F20	15.47	-11.60	1.76	-8.01
(P6×P9) F21	-23.02	-22.40	-3.55	-5.61
(P9×P1) F22	-30.72	-27.60	-4.43	-6.41
(P9×P2) F23	46.27	84.81	-2.66	-7.21
(P9×P3) F24	0.08	22.00	-4.43	-6.41
(P9×P6) F25	7.78	-9.60	-4.43	-6.41
(P9×P7) F26	15.47	-15.60	-2.66	-4.81
(P9×P10) F27	-7.62	-16.00	-5.32	-4.81
S.E	5.54	7.01	0.68	0.48

Table 6. Heterosis (%) for cucumber hybrids obtained from direct crossings (compared to the highest control hybrids) in terms of the yield and it components, and compared to the lowest control hybrids in terms of the diameter of the fruit in spring 2017

Characters / Genotype	fruit Weight	Experimental unit's yield	fruit Length	fruit Diameter
(P2×P1) F1	-11.92	6.11	-1.80	19.14
(P2×P3) F2	27.00	19.57	33.01	-10.01
(P2×P5) F3	27.58	25.16	11.59	22.94
(P2×P6) F4	24.62	29.98	16.94	19.14
(P2×P9) F5	-7.08	12.17	41.94	9.00
(P2×P10) F6	11.30	27.70	58.90	22.94
(P3×P1) F7	3.35	35.47	19.62	30.54
(P3×P5) F8	2.72	48.72	15.16	27.38
(P3×P6) F9	2.59	13.35	28.55	19.14
(P3×P9) F10	-5.69	38.61	26.76	12.04
(P3×P10) F11	-5.15	13.26	37.48	23.70
(P5×P2) F12	-17.11	-2.88	2.66	34.98
(P5×P3) F13	-10.14	31.86	5.87	26.74
(P5×P4) F14	-28.34	-9.65	-5.37	29.40
(P5×P7) F15	1.82	32.27	-3.14	19.14
(P5×P8) F16	-0.05	38.41	0.87	26.74
(P5×P9) F17	32.49	46.74	-0.91	15.34
(P6×P1) F18	-10.83	31.10	-6.71	22.94
(P6×P2) F19	1.74	7.13	-5.37	17.87
(P6×P3) F20	5.05	18.81	-0.02	7.73
(P6×P9) F21	0.57	50.80	-2.70	19.14
(P9×P1) F22	-10.53	26.85	8.02	19.14
(P9×P2) F23	-2.50	14.12	26.76	7.73
(P9×P3) F24	4.76	11.07	42.83	26.74
(P9×P6) F25	-9.09	49.28	28.55	-11.28
(P9×P7) F26	-8.50	32.39	45.51	7.73
(P9×P10) F27	0.95	66.79	57.11	7.73
S.E	2.72	3.62	3.89	2.13

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