Effect of row spacing on growth, yield and yield components of cucumber varieties

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Abstract

Experiment was conducted at Horticulture research farm, NWFP Agricultural University, Peshawar during June 2008, in a randomized complete block design with three replicates to study the effect of row spacing of 1.0, 1.5 and 2.0 meter on three cultivars of cucumber; Desi 36 Days, Cucumber Long Great and Cucumber Desi cultivar. Finding showed that all the parameter except fruit length was significantly affected by different cultivars. The effect of row space remained non-significant for all parameters except fruit length and final fruit yield. The interaction between cultivars and row space was not significant for all parameters. Cultivar Desi 36 Days resulted in maximum plant survival (%), lesser days to initial flowering, longer stem diameter (cm), few days to fruit setting, thicker fruit diameter (cm), elongated leaf length, more fruit plant $^{-1}$ and highest fruit yield t ha $^{-1}$. Cucumber cultivar Long Great gave maximum emergence (%), minimum plat survival (%) and shorter fruit diameter (cm). More days to initial flowering, least emergence (%), shorter stem diameter (cm), more days to fruit setting, shorter leaf length , least fruit plant $^{-1}$, and lower fruit yield kg ha^{-1} was recorded by Cucumber Desi. Maximum fruit length and higher fruit yield t ha^{-1} was noted at 1.5 m row spacing, whereas minimum fruit length was recorded 1 m row spacing. Row spacing of 2 m resulted in lower fruit yield of cucumber.
Key words: cucumber varieties; growth; row spacing; yield components.

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Introduction

Cucumber (*Cucumis sativus* L) is an important member of the family *Cucurbitaceae*. The crop is of Asian origin, the progeny may be closely related to the wild *Cucumis sativus* var. *hardwickii*, which was first found in the Himalayan foothills of Nepal. Cucumber cultivation goes back to at least 3000 years in India and 2000 years in china [1]. Cucumber is cultivated on a large scale in the Indo-Pakistan subcontinent. Pakistan annually produces about 6847 tons of fresh cucumber according to statistic (2005-06); its market value at current factor cost is estimated around US$2 billion. The annual export of fresh produce is estimated around half a million tons which earns foreign exchange worth US$140 million. Horticulture is a growing industry and pace of both production and exports can be much accelerated.

The fruits are eaten as salad and pickle and are often consumed as cooked vegetables in various ways. It contains 0.6g protein, 2.6g carbohydrate, 12cal energy, 18mg Ca, 0.2mg Fe, 0.02mg thiamin, 0.02mg riboflavin, 0.01mg niacin, and 10mg vitamin C/100g of edible portion [2].

Cucumber requires high temperatures and is planted either in the spring or summer. They are very sensitive to cold and are killed by even a light frost. Cucumber is an annual deep-rooted crop with tendrils and hairy leaves. The plants may have an indeterminate, determinate, or a compact plant habit.

The compact growth habit consists of plants with shorter internodes length than plants with in terminate or determinate growth habit. Optimum growth occurs between 75-90 ºF, while growth reduction occurring below 60 ºF and above 90 ºF.

The flowers are monoecious and flowering start normally 40-45 days after sowing depending on the weather conditions. Under long days and high light intensities male (staminate) flowers predominate, whereas under short days and low light intensities female (pistillate) flowers predominate [3].

Parthenocarpic cultivars will produce seedless fruit in the absence of bees and pollination during the crop growth cycle. If bees are present for pollination, parthenocarpic plants will yield normal seeded fruits but fruit may be off-shaped.

The present experiment was conducted with the aim to find out the effect of row spacing on growth and yield of various cucumber cultivars, to study the environmental effect of Peshawar valley on these cultivars of cucumber.

Materials and methods

Experimental details

An experiment was conducted during summer 2008 at horticulture research farm of NWFP Agricultural University Peshawar to study the effect of row spacing (1m, 1.5m and 2m) on three cucumber

cultivars, Desi 36 Days, Cucumber Desi, and Long Great. The experiment was arranged in a randomized complete block design with three replications. The size of each experimental plot was 3m by 5m. The crop was sown on June 8, 2008. Pre-emergence herbicides were used to control weeds at early growth stages. Also plots were regularly hand-weeded until canopy was closed to prevent weed damage. Insecticides were used to prevent insect damage. All other agronomic practices were used according to local recommendations to avoid yield loss.

Crop growth and yield parameters

The following different growth and yield parameters were studied during this experiment.

Emergence and plant survival percentage

The data was recorded daily from the date of sowing till sprouting of each cultivar for emergence percentage and till the plant started production for plant survival percentage and average was calculated.

Stem diameter and leaf length (cm)

Stem diameter was measured with the help of vernier caliper at upper, middle and the base of randomly selected plants and leaf length was calculated by using measuring tape and averages were calculated.

Days to first flowering and fruit setting

Regular observations were taken and days from the date of sowing to first flowering and fruit setting in each cultivar were noted.

Fruit diameter and length (cm)

Diameter of the fruits and their lengths were measured with the help of vernier caliper after the fruit reached to edible maturity.

Number of fruit per plant and yield (kg ha^{-1})

The data of fruits per plant was calculated by counting fruits from selected plants and average was calculated. After harvesting, yield per ha was calculated by the following formula.

$$\text{Yield/ha} = \frac{\text{Yield (kg)} \times 10000 \text{ m}^2}{\text{Area of plot}}$$

Statistical analysis

The data was statistically analyzed according to the method appropriate for RCB design. Upon obtaining significant differences, least significant difference (LSD) test was employed [8].

Results and discussion

Emergence (%)

Data regarding emergence (%) indicated that the effect of different cultivars were significant, whereas row space did not differ significantly (Table 1). The interaction between the two factors was also non-significant. Mean value of the data showed that maximum emergence (86 %) was observed in cultivar Long Great, followed by cultivar Desi 36 Days (81 %), whereas minimum emergence (63 %) was recorded in cultivar Cucumber Desi. Although row spacing has non-significant effect on emergence, however higher emergence (77 %) was noted at both 1.5 and 2 m row spacing apart, whereas lower emergence (76 %) was observed at 1 m row space. It might be due to the uniform emergence at different row spacing, which resulted in insignificant effect on emergence. Interaction between cultivars and row spacing also remain insignificant, however maximum emergence (87 %) was noted in cultivar Long Great at 1.5 m row space, whereas minimum emergence (62 %) was observed in cultivar Cucumber Desi at row space of 1m. Difference in emergence might be due to the genetic potential of each cultivar. The results are in consensus with Ahmed et al [4] who reported difference in emergence among different cultivars of cucumber.

Table 1: Emergence (%) as affected by different cultivars and row spacing

Row spacing (m)	Desi36 Days	Cucumber Desi	Long Great	Mean
1	80	62	86	76
1.5	82	63	87	77
2	81	63	86	77
Mean	81b	63c	86a	

LSD = 2.06; values with different letters are significantly different at 5% level of probability.

Plant survival (%)

Statistical analysis of the data showed that different cultivars significantly affected plant survival, whereas the effect of row spacing was not significant. The interaction between the two factors was also non-significant. The result related with Rehman et al [5] row spacing and their interaction

was found non-significant. The data showed that maximum plant survival (97%) was recorded in cultivar Desi 36 Days followed by cultivar Cucumber Desi (84%), whereas minimum plant survival (79%) was recorded in cultivar Long Great (Table 2). It might be due to the difference between genetic potential of the cultivars. This might be due to the fact that cultivar Desi 36 Days was fully adapted to the ecological condition of experimental area, hence proved its higher survival. Although row spacing have non-significant response on plant survival, however higher survival (87%) was noted in 1.5m row spacing, whereas less survival (86%) was observed at both 1m and 2 m row spacing. Results are also in agreement with Rahman et al [5] showing that the row spacing of 40, 60, 80 and 100cm had no significant effect on plant survival in Tomato. Interaction between cultivars and row spacing was also non-significant, however maximum survival (97%) was observed by cultivar Desi 36 Days at 1.5m and 2m row spacing, whereas minimum survival (78%) was noted for cultivar Long Great at row spacing of 2m.

Table 2: Survival percentage as affected by different cultivars and row spacing

Row spacing (m)	Desi36 Days	Cucumber Desi	Long Great	Mean
1	96	83	80	86
1.5	97	85	79	87
2	97	83	78	86
Mean	97a	84b	79c	

LSD = 1.79; values with different letters are significantly different at 5% level of probability.

Stem diameter

Data regarding stem diameter were presented in table 3 and the statistical analysis of the data revealed that different cultivars significantly affected stem diameter whereas the effect of row space was not significant. The interaction between cultivars and row space was also not significant. It is made clear from data that cultivar Desi 36 days resulted in maximum stem diameter (1.79 cm), whereas minimum stem diameter (1.61 cm) was observed by cultivar Cucumber Desi. It might be due to the genetic potential of the cultivar. The results are in line with Mathieu et al [4] who reported different stem diameter for different cucumber cultivars. As row space effect on stem diameter did not differ significantly, however maximum stem diameter (1.74 cm) was noted in spacing of 1.5 m, while minimum stem diameter (1.68 cm) in row space of 1m. Stem diameter is an inherited characteristic of a cultivar and thus row space did not influence upon stem

diameter. In case of interaction between row space and cultivars, maximum stem diameter (1.81 cm) was observed by cultivar Desi 36 days at row space of 1.5 m apart, while lower stem diameter (1.54 cm) was noted by cultivar Cucumber desi at 1m row space apart.

Table 3: Stem diameter as affected by different cultivars and row spacing

Row spacing (m)	Desi36 Days	Cucumber Desi	Long Great	Mean
1	1.80	1.54	1.71	1.68
1.5	1.81	1.67	1.73	1.74
2	1.75	1.63	1.74	1.71
Mean	1.79a	1.61b	1.73a	

LSD = 0.09; values with different letters are significantly different at 5% level of probability.

Leaf length (cm)

Data concerning leaf length are presented in table 4 and perusal of the data indicated that the effect of different cultivars were significant on leaf length. The effect of row spacing was non-significant. The interaction between cultivars and row spacing was also non-significant. It is clear from the mean values that maximum leaf length (18 cm) was observed in cultivar Desi 36 Days, followed by cultivar Long Great (17 cm), whereas minimum leaf length (16 cm) was recorded by cultivar Cucumber Desi which was statically at same level. In case of row spacing although non-significant response to leaf length was observed, however longer leaf (17 cm) was noted in both 1 and 1.5 m row space apart, whereas shorter leaf (16 cm) was observed at 2 m row space. Interaction between cultivars and row spacing also remain insignificant, however maximum leaf length (19 cm) was noted by cultivar Desi 36 Days at 1 m row space, whereas minimum leaf length (16 cm) was observed by all the three cucumber cultivars at row space of 2m.

Table 4: Leaf length as affected by different cultivars and row spacing

Row spacing (m)	Desi36 Days	Cucumber Desi	Long Great	Mean
1	19	16	17	17
1.5	18	17	17	17
2	16	16	16	16
Mean	18a	16c	17b	

LSD = 0.86; values with different letters are significantly different at 5% level of probability.

Days to flowering

Data concerning days to flowering is shown in table 5 and analysis of the data suggested that different cultivars significantly affected days to flowering whereas the effect of row spacing was not

significant. The interaction between cultivars and row spacing was also non-significant. It is clear from the data that cultivar Cucumber Desi took maximum days to flowering (44), whereas the cultivar Desi 36 Days took lesser days to flowering (33). It might be due to the genetic potential of the cultivar. The results are in agreement with Ahmad et al [4] who reported that cultivars Market More and Poinsett-76 took minimum time to start flowering as compared to other cultivars evaluated. In case of row spacing, 1 m apart rows took maximum of (40 days) to flowering whereas 1.5 m apart rows resulted in minimum days to flowering (38 days), which were at par with each other. Interaction between row spacing and cultivars exhibited that maximum days to flowering (48) were taken by the cultivar Cucumber Desi in row space of 1 m apart, while less days to flowering (33) was taken by the cultivar Desi 36 Days in 2 m row space.

Table 5: Days to flowering as affected by different cultivars and row spacing

Row spacing (m)	Desi36 Days	Cucumber Desi	Long Great	Mean
1	34	49	39	41
1.5	34	40	39	38
2	34	44	40	39
Mean	3c	44a	40b	

LSD = 2.48; values with different letters are significantly different at 5% level of probability.

Days to fruit setting

Data regarding days to fruit setting are shown in table 6 and study of the data indicated that different cultivars significantly affect days to fruit setting, whereas the effect of row spacing was not significant. The interaction between the cultivars and row space was also non-significant. Mean value of the data showed that maximum days to fruit setting (59 days) was observed in the cultivar Cucumber Desi, followed by cultivar Long great (56 days), whereas minimum days to fruit setting (44 days) was recorded in the cultivar Desi 36 days. It might be due to the fact that the cultivar Desi 36 days was short duration variety and hence took minimum days to fruit setting. Similar results were also reported by Ahmad et al [4] who found that cultivars Market More and Poinsett-76 took minimum time to start flowering and fruit setting as compared to other cultivars tested. Row spacing gave non-significant response to Days to fruit setting, however late Days to fruit setting (53 days) was noted in both 1 and 2 m row space apart, whereas early Days to fruit setting (52 days) was observed at 1.5 m row space. Interaction between cultivars and row space also remain insignificant, however maximum days taken to fruit setting (60)

was observed by cultivar Cucumber Desi at 1 m row space, whereas less days taken to fruit setting (44) was shown by cultivar Desi 36 days at row space of 1m.

Table 6: Days to fruit setting as affected by different cultivars and row spacing

Row spacing (m)	Desi36 Days	Cucumber Desi	Long Great	Mean
1	44	60	56	53
1.5	45	57	55	52
2	45	59	56	53
Mean	44c	59a	56b	

LSD = 1.35; values with different letters are significantly different at 5% level of probability.

Fruit diameter

Data pertaining fruit diameter is presented in table 7 and investigation of the data indicated that different cultivars significantly affected fruit diameter whereas the effect of row spacing was non-significant. The interaction between cultivars and row spacing was also non-significant. It is pointed out that Desi 36 Days recorded maximum fruit diameter (5.27 cm), whereas minimum fruit diameter (4.45 cm) was observed in Long Great cultivar. It might be due to the genetic potential of the cultivar. The results are in line with Ahmed et al [4] who reported that the cultivar "Punjab Local "produced fruit having the maximum diameter (4.59 cm) as compared to other cultivars evaluated. In case of row spacing, maximum fruit diameter (5 cm) was recorded in row spacing of 1.5 m, while minimum fruit diameter (4.65 cm) in row spacing of 2 m which were statistically at same level. Interaction between row spacing and cultivars showed that maximum fruit diameter (5.45 cm) was observed in Desi 36 Days at row spacing of 1.5 m, while shorter fruit diameter (4.33 cm) was observed in Long Great at 1m row spacing.

Table 7: Fruit diameter (cm) as affected by different cultivars and row spacing

Row spacing (m)	Desi36 Days	Cucumber Desi	Long Great	Mean
1	5.41	4.50	4.33	4.75
1.5	6.70	3.90	3.50	5.00
2	4.95	4.63	4.37	4.65
Mean	5.27a	4.69b	4.45b	

LSD = 0.48; values with different letters are significantly different at 5% level of probability.

Fruit length (cm)

Statistical analysis of the data (Table 8) indicated that the effect of different row spacing were significant, whereas cultivars did not differ widely. The interaction between the two factors was also non-significant. Mean value of the data showed that maximum fruit length (15.57) was noted at 1.5 m row

spacing, followed by 2m row spacing (14.82), whereas minimum fruit length (14.21) was recorded 1 m row spacing. Fruit length might be the genetic potential of each cultivar and there is variation exist among different cultivars of cucumber. Our findings are supported by Ahmed et al [4] who find out cucumber cultivar "Market More" produced greater fruit length as compared to other cultivars tested. In case of cultivars although non-significant response to fruit length, however higher fruit length (15.27) was noted Long Great, whereas smaller fruit length (14.33) was observed in Cucumber Desi. Interaction between cultivars and row spacing also remain insignificant, however maximum fruit length (16) was noted by Desi 36 Days at 1.5 m row spacing, whereas minimum fruit length (13.67) was observed by Cucumber Desi at row spacing of 1m.

Table 8: Fruit length (cm) as affected by different cultivars and row spacing

Row spacing (m)	Desi36 Days	Cucumber Desi	Long Great	Mean
1	14	13.67	14.97	14.21b
1.5	16	15.00	15.70	15.57a
2	15	14.33	15.13	14.82b
Mean	15	14.33	15.27	

LSD = 0.91; values with different letters are significantly different at 5% level of probability.

Number of fruits plant [-1]

Data regarding fruit plant [-1] are presented in table 9 checking of the data indicated that the effect of different cultivars and row spacing was significantly affected by number of fruits plant[-1]. The interaction between the cultivars and row spacing was not significant. Mean value of the data showed that maximum fruit plant [-1] (5.7) was obtained by Desi 36 Days, followed by Long Great (3.6) and minimum fruit plant [-1] (3.3) was observed by Cucumber Desi. The results are in line with Mathieu et al [7] and Ahmad et al [4] reported similar results who found maximum number fruit plant[-1] resulted from cultivar Market More. The results are in line with Ahmed et al [4] who investigated that cucumber cultivar "Market More" produced maximum number of fruit per plant with greater fruit length as compared to other cultivars tested. Row spacing revealed that greater number of fruit plant [-1] (4.7) was noted in 1.5 m row spacing apart, whereas lesser fruit plant [-1] (3.4) was got at 2 m row spacing. It might be due to the optimum space, light and maximum availability of nutrients consumed by the plants in row spacing of 1.5 m apart which resulted in greater number of fruits plant[-1]. Interaction between cultivars and row spacing was insignificant, however maximum fruit plant [-1]

(6.7) was noted by Desi 36 Days at 1.5 m row spacing, whereas minimum fruit plant [-1] (2.7) was observed by Long Great at row spacing of 2m.

Fruit Yield (kg ha^{-1})

Data pertaining fruit yield indicated that the effect of different cultivars and row spacing were significant on fruit yield of cucumber, whereas the interaction between the two factors was non-significant (Table 10). The data showed that maximum fruit yield ha [-1] (11977 kg ha^{-1}) was produced by Desi 36 Days followed by Cucumber Desi (11425 kg ha^{-1}), whereas minimum yield ha^{-1} (11353 kg ha^{-1}) was observed by Long Great. Higher fruit yield of Desi 36 Days could be attributed to more number of fruits per plant and greater fruit length, fruit diameter and higher plant survival. The results are in line with Hochmuth et al [6] who reported that different cultivars of cucumber resulted in different fruit yield. Ahmad et al [4] reported similar results that found that maximum fruit yield plant[-1] and per hectare was obtained from the cultivar Market More, followed by the cultivar Poinsett-76. In case of row spacing it is pointed out that greater fruit yield (11904 kg ha^{-1}) was resulted in 1.5 m row spacing apart, whereas lesser yield (11246 kg ha^{-1}) was produced in plots where plants were sown at row spacing of 2 m apart. Optimum plant densities have great impact on fruit yield plant[-1] and hence yield ha^{-1} [8]. It might be due to the fact that yield decreased in row space of 2 m apart as number of plants ha^{-1} decreased. Interaction between cultivars and row spacing also insignificant, however maximum yield (12240 kg ha^{-1}) was noted by Desi 36 Days at 1.5 m row spacing, whereas minimum yield (10883 kg ha^{-1}) was observed by Long Great at row spacing of 2m.

Table 9: Number of fruit plant [-1] as affected by different cultivars and row spacing

Row spacing (m)	Desi36 Days	Cucumber Desi	Long Great	Mean
1	5.6	3.2	4.5	4.5a
1.5	6.7	3.9	3.5	4.7a
2	4.7	2.9	2.7	3.4b
Mean	5.7a	3.3b	3.6b	

LSD = 0.64; values with different letters are significantly different at 5% level of probability.

Table 10: Fruit yield as affected by different cultivars and row spacing

Row spacing (m)	Desi36 Days	Cucumber Desi	Long Great	Mean
1	11950	11425	11440	11605a
1.5	12240	11735	11736	11904a
2	11742	11114	10883	11246b
Mean	11977a	11425b	11353b	

LSD = 316.8; values with different letters are significantly different at 5% level of probability.

References

[1] Robinson RW, Walters DS. Cucubits University press, Cambridge London, UK; 1997, p. 14-115.

[2] Rashid MM. Sabgi Biggan (in Bangla). Rashid Publishing House, Dhaka; 1999, p. 303.

[3] George RAT. Vegetable Seed Production. Pitman Press, Bath, UK; 1985.

[4] Ahmed M, Hamid A, Akbar Z. Growth and yield performance of six cucumber (*Cucumis sativus* L.) cultivars under agro-climatic conditions of Rawalakot, Azad Jammu and Kashmir. Int J Agric Bio 2004; 6:396-399.

[5] Rahman WQ, Sajid M, Shahenshah, Khan H, Rahman QL, Ahmad D, Wahid F, Muhammad Z. Effect of different herbicides and row spacing on the growth and yield of tomato (*Lycopersicon esculentum* L.). Pak J Weed Sci Res 2012; 18: 157-165.

[6] Hochmuth RC, Davis LL, Simonne EH, Sargent SA, Laughlin WL, Berry A (2004) Evaluation of twelve greenhouse Beit-alpha cucumber varieties and two growing systems. In: VII International Symposium on Protected Cultivation in Mild Winter Climates: Production, Pest Management and Global Competition. 2004, p. 461-466.

[7] Mathieu N, Guangyao W, Hausbeck MK. Changes in pickling cucumber yield and economic value in response to planting density. J Crop Sci 2006; 46:1570-1575.

[8] Steel GD, Torrie JH. Principles and procedures of statistics, 2nd ed. McGraw Hill Book Co. Inc New York; 1980.