www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(7): 680-683

www.thepharmajournal.com
Received: 01-05-2022
Accepted: 06-06-2022

KS Vaghela
Department of Vegetable Science, Navsari Agricultural University, Navsari, Gujarat, India

VK Parmar
Department of Fruit Science, Navsari Agricultural University, Navsari, Gujarat, India

YN Tandel
Department of Fruit Science, Navsari Agricultural University, Navsari, Gujarat, India

Upma Gamit
Department of Vegetable Science, Navsari Agricultural University, Navsari, Gujarat, India

Corresponding Author:
KS Vaghela
Department of Vegetable Science, Navsari Agricultural University, Navsari, Gujarat, India

Effect of varieties and spacing on growth, physiological attributes and yield of onion under South Gujarat condition

KS Vaghela, VK Parmar, YN Tandel and Upma Gamit

DOI: https://doi.org/10.22271/tpi.2022.v11.i7i.13729

Abstract
The experiment was conducted to find out the effect of spacing and varieties on onion at Navsari Agricultural University during year 2020-21 and 2021-22. The experiment was arranged over 12 treatment combinations comprising of three varieties (V_1: GJRO-11, V_2: Agrifound Light Red and V_3: NHRDF Red-3) and 4 levels of spacing (S_1: 15 cm × 7.5 cm, S_2: 15 cm × 10 cm, S_3: 15 cm × 12.5 cm and S_4: 15 cm × 15 cm) in factorial randomized block design (RBD) with three replications. Among the varieties, GJRO-11 variety was superior in growth and physiological parameters *viz.* plant height, leaf area, crop growth rate, relative growth rate, and absolute growth rate and biomass duration. Whereas, minimum bolting and maximum average bulb weight and marketable bulb yield was recorded in NHRDF Red-3 and lesser days to maturity of plant was recorded in Agrifound Light Red. The higher plant height, leaf area, relative growth rate, absolute growth rate and biomass duration was observed in spacing of 15 cm × 15 cm. Whereas, maximum crop growth rate, average bulb weight and marketable bulb yield and minimum number of bolting, lesser days to maturity was recorded in spacing of 15 cm × 7.5 cm. The maximum average bulb weight was observed in NHRDF Red-3 with 15 cm × 15 cm. whereas, maximum marketable bulb yield was noted in the treatment combination of NHRDF Red-3 with 15 cm × 7.5 cm.

Keywords: Onion, varieties, spacing, growth, physiological, yield

Introduction
India is populated country and most of our vegetarian. The growing of vegetables and its storage after harvesting is the expensive but profitable and remunerative business and can be easily adopted by small farmers. It is considered to be the second most important vegetable crop grown in the world after tomato. It is popularly referred as "Queen of Kitchen" or "Poor Man's *Kasturi*" because of indispensable item in every kitchen as vegetable and condiment. India is the second largest producer of onion in the world with a prominent production and export. Onion has received considerable attention for its high medicinal values. The bulbs are acrid, sweet, aromatic, thermogenics, antiperiodic, antibacterial, aphrodisiac, expectorant, stimulant, carminative, appetite, stomachic, diuretic, anodyne and tonic. Consumption of onions may prevent gastric ulcers by scavenging free radicals and by preventing growth of the ulcer-forming microorganism. Researchers found that the more pungent onions exhibit strong anti-platelet activity. Platelet aggregation is associated with diseases like atherosclerosis, cardiovascular disease, heart attack and stroke (Manach *et al.*, 2005) [5].
Onion is contributing more in economic as well as health, so its production and productivity required to scaled level. Proper agronomic management practices and new technology are still not highly used which have an undoubted contribution in increasing crop yield potential.
Successful onion production depends on the selection of varieties that are adapted to different climatic condition imposed by specific environment and spacing generally dependent upon the expected growth of a particular crop plant variety in a given agro-climatic region. One of the important measures to be taken in increasing the productivity of onion is determining spacing for each agro-ecology since full package of information is required for each growing region of the country to optimize onion productivity (Gupta *et al*., 1994) [1]. Optimum plant population is one of the important factors for optimum utilization of solar energy and soil nutrients to increase the yield per hectare of onion crop, where only single underground bulb is produced per plant. Higher plant population can be achieved by reducing the distance between two rows or between two plants within the row.

Hence, the use of proper geometry to get appropriate plant stand is a pre-requisite for higher crop yield per unit area. Keeping in view the above mentioned facts and information of onion, the study was conducted to determine the effect of spacing and varieties on growth, physiological attributes and yield of onion.

Materials and Methods

The present investigation was laid out at Vegetable Research Farm, Regional Horticultural Research Station, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari during *rabi* season of 2020-21 and 2021-22. According to agro-climatic conditions of Gujarat state, Navsari falls under 'South Gujarat Heavy Rainfall Zone, AES-III'. The climate of this zone is typically tropical and monsoonic. An average rainfall of the tract is about 1500 mm and is normally receive by second fortnight of June and cease by September end.

The soil is black cotton soil with a pH of 7.40 and 6.70, available nitrogen (260.02 and 268.06 kg ha^{-1}), medium in available phosphorus (45.80 and 44.32 kg ha^{-1}) and available potash (360.81 and 361.20 kg ha^{-1}), respectively. The experiment is conducted in factorial randomized block design with three varieties (GJRO-11, Agrifound Light Red and NHRDF Red-3) and four spacing (15 cm x 7.5 cm, 15 cm x 10 cm, 15 cm x 12.5 cm and 15 cm x 15 cm). All treatments were replicated three times. Seedling was selected and transplanted on 12th and 14th December in 2020 and 2021 and harvested on 19th April and 20th April in 2021 and 2022, respectively. Farmyard manure was applied at the rate of 20 t ha^{-1} uniformly and incorporated into the soil at the time of land preparation. The chemical fertilizers were applied at the rate of 100:50:50 NPK kg ha^{-1}, respectively. The half quantity of nitrogen, phosphorus and potash was applied as a basal dose in the form of urea, single super phosphate and muriate of potash, respectively. Remaining half quantity was applied in two equal splits at 30 and 45 days after transplanting. For the establishment of the crop, first light irrigation was given just after transplanting of seedling then subsequent irrigations were given at 10 days interval and irrigation was withhold before 15 days of harvesting. Onion is a shallow rooted crop, therefore shallow hoeing was done twice or thrice for weed control. Hand weeding was also done as and when required

The observation was made on the following parameters plant height (cm) at 45 DATP and 90 DATP, bolting (%), days to maturity, leaf area (cm^2) at 90 DATP, crop growth rate (g m^2 day^{-1}), relative growth rate (g g^{-1} day^{-1}), absolute growth rate (g day^{-1}), biomass duration (g days), average bulb weigh and marketable bulb yield (t ha^{-1}) of bulbs. All the parameters were collected from five randomly selected plants of each treatment with three replication for observation. All physiological parameters were observed through particular scientific method and formula. Statistical analysis of data obtained in different set of experiments was calculated following the standard procedure as stated by Panse and Sukhatme (1985) [7].

Results and Discussion

Effect of varieties on growth, physiological and yield parameters of onion

The data (Table. 1) revealed that plant height, bolting (%), days to maturity, leaf area, crop growth rate, relative growth rate, absolute growth rate, biomass duration, average weight of bulb and bulb yield were significantly influenced by varieties. Maximum plant height at 45 DATP (59.62, 60.21 and 59.91), plant height at 90 DATP (70.92, 71.49 and 71.21 cm), leaf area (100.96, 102.20 and 101.58 cm^2 at 90 DATP), crop growth rate (3.86, 4.17 and 4.01 g m^{-2} day^{-1}), relative growth rate (0.0275, 0.0299 and 0.0287 g g^{-1} day^{-1}), absolute growth rate (0.063, 0.069 and 0.066 g day^{-1}) and biomass duration (578.53, 587.37 and 582.95 g day) was reported in GJRO-11 and lesser days to maturity of plant (114.38, 113.74 and 114.06 days) was recorded in Agri found Light Red during individual years and in pooled analysis, respectively. Whereas, maximum average bulb weight (86.94, 89.78 and 88.36 g), marketable bulb yield (34.74, 38.68 and 36.71 t ha^{-1}) and minimum bolting (3.19, 3.34 and 3.27%) was reported with variety NHRDF Red-3 (V_3) during individual years of experiment and in pooled analysis, respectively. The difference in behavior of the varieties could be explained by the variation in their genetic make-up and differential behavior under different climatic condition. These observations corroborated the findings of Jilani and Ghafoor (2003) [2] in onion.

Effect of spacing on growth, physiological and yield parameters of onion

The data depicted in Table. 2 revealed that the spacing treatments had significant effect on plant height, bolting (%), days to maturity, leaf area, crop growth rate, relative growth rate, absolute growth rate, biomass duration, average weight of bulb and bulb yield. The higher plant height at 45 DATP (59.62, 60.28 and 59.95 cm at 45), plant height at 90 DATP (71.09, 71.53 and 71.31 cm at 90 DATP), leaf area (103.99, 106.18 and 105.09 cm^2 at 90 DATP), relative growth rate (0.0266, 0.0304 and 0.0285 g g^{-1} day^{-1}), absolute growth rate (0.061, 0.070 and 0.066 g day^{-1}), biomass duration (575.79, 587.29 and 581.54 g day) and average weight of bulb (98.67, 101.50 and 100.08 g) was observed in plant spacing 15 cm × 15 cm (S_4) during first year, second year and in pooled analysis, respectively. This may be due to wider spacing reduce the number of plant population and competition for the growth factors like water, nutrient and light which may lead to better growth, adequate nutrient, moisture and light which helped to increase the average weight of bulb per plant and more dry matter accumulation per unit time which increase growth of plant as compared to closer plant spacing as explained by Jilani and Ghafoor (2003) [2] in onion.

Whereas, maximum crop growth rate (3.80, 4.12 and 3.96 g m^{-2} day^{-1}) and marketable bulb yield (t ha^{-1}), minimum number of bolting (2.12, 2.23 and 2.18%) and lesser days to maturity (114.67, 113.91 and 114.29 days) was found at plant spacing of 15 cm × 7.5 cm (S_1). The yield was highest in closer spaced plants which might be due to accommodation of more plants per unit area followed by intermediate spacing and the lowest yield was observed with wider spaced plants. Similar result was reported by Singh and Bhonde (2011) [9] and Singh and Singh (2019) [8] in onion.

Combine effect of varieties and spacing on growth, physiological and yield parameters of onion

It is seen from the results given in table that growth and physiological parameters was significantly not affected by combine of varieties and spacing, but yield parameters was found significant result. The maximum average bulb weight (109.92, 112.75 and 111.33 g) was observed in V_3S_4 (NHRDF

Red-3 with 15 cm × 15 cm spacing). Average bulb weight within varieties was due to their genetic variability as well as wider spacing provides more area, light and less nutrient competition among plants, which increase weight of bulb in onion. Varying response in respect to average bulb weight had also been reported by Khan *et al.* (2003) [3]. Whereas, maximum marketable bulb yield (36.33, 39.90 and 38.12 t ha^{-1}) was observed in the treatment combination of V_3S_1 (NHRDF Red-3 with 15 cm × 7.5 cm spacing). Marketable bulb yield within varieties was due to their genetic variability as well as closer spacing might be attributed to optimum number of plant population per unit area which leads to maximum number of bulbs. Thus, the marketable bulb yield of onion per unit area does not completely depend up on the performance of individual plants of bulb but also related with the total number of plant per unit area. Similar results were showed by Kishor *et al.* (2017) [4] and Maurya *et al.* (2019) [6].

Table 1: Effect of varieties and spacing on growth characters of onion

Treatments	Plant Height at 45 DATP			Plant Height at 90 DATP			Bolting (%)			Days to maturity (Days)		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
Varieties (V)												
V_1 (GJRO-11)	59.62	60.21	59.91	70.92	71.49	71.21	3.19	3.34	3.27	121.25	120.38	120.81
V_2 (Agrifound Light Red)	57.07	57.71	57.39	68.79	69.44	69.12	2.11	2.18	2.15	114.38	113.74	114.06
V_3 (NHRDF Red-3)	58.20	59.16	58.68	69.21	69.94	69.58	1.81	1.98	1.89	117.88	117.24	117.56
S.Em±	0.24	0.39	0.23	0.26	0.44	0.26	0.06	0.04	0.04	0.60	0.34	0.35
C.D. at 5%	0.71	1.13	0.65	0.75	1.30	0.73	0.18	0.12	0.10	1.77	1.01	0.99
Spacing (S)												
S_1 (15 cm × 7.5 cm)	56.95	57.62	57.28	68.18	69.15	68.67	2.12	2.23	2.18	114.67	113.91	114.29
S_2 (15 cm × 10 cm)	57.80	58.74	58.27	69.06	69.95	69.51	2.29	2.42	2.35	116.33	115.60	115.97
S_3 (15 cm × 12.5 cm)	58.82	59.47	59.14	70.23	70.54	70.38	2.42	2.58	2.50	118.67	117.99	118.33
S_4 (15 cm × 15 cm)	59.62	60.28	59.95	71.09	71.53	71.31	2.65	2.78	2.72	121.68	120.96	121.32
S.Em±	0.28	0.45	0.26	0.30	0.51	0.29	0.07	0.05	0.04	0.70	0.40	0.40
C.D. at 5%	0.82	1.31	0.75	0.87	1.50	0.84	0.21	0.14	0.12	2.04	1.17	1.14
Interaction (V×S)												
S.Em±	0.48	0.77	0.46	0.51	0.88	0.51	0.12	0.08	0.07	1.21	0.69	0.70
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.V. %	1.43	2.27	1.90	1.27	2.18	1.79	8.97	5.59	7.39	1.77	1.02	1.45
Pooled Interaction												
Source	Y×V	Y×S	Y×V×S	Y×V	Y×S	Y×V×S	Y×V	Y×S	Y×V×S	Y×V	Y×S	Y×V×S
S.Em. ±	0.32	0.37	0.65	0.36	0.42	0.72	0.05	0.06	0.10	0.49	0.57	0.98
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 2: Effect of varieties and spacing on physiological attributes of onion

Treatments	Leaf area (cm^2) at 90 DATP			Crop Growth Rate (g m^{-2} day^{-1})			Relative Growth Rate (g g^{-1} day^{-1})			AGR (g day^{-1})			BMD (g day)		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
Varieties (V)															
V_1 (GJRO-11)	100.96	102.20	101.58	3.86	4.17	4.01	0.0275	0.0299	0.0287	0.063	0.069	0.066	578.53	587.37	582.95
V_2 (Agrifound Light Red)	96.38	97.09	96.74	2.47	2.83	2.65	0.0173	0.0200	0.0187	0.040	0.046	0.043	546.41	552.54	549.48
V_3 (NHRDF Red-3)	97.53	99.69	98.61	3.25	3.60	3.43	0.0231	0.0257	0.0244	0.053	0.059	0.056	574.89	580.35	577.62
S.Em±	1.19	0.64	0.67	0.19	0.12	0.11	0.0013	0.0008	0.0008	0.003	0.002	0.002	4.07	4.05	2.87
C.D. at 5%	3.48	1.87	1.92	0.55	0.35	0.32	0.0037	0.0024	0.0021	0.009	0.006	0.005	11.93	11.88	8.18
Spacing (S)															
S_1 (15 cm × 7.5 cm)	93.73	94.59	94.16	3.80	4.12	3.96	0.0185	0.0201	0.0193	0.043	0.046	0.044	552.56	559.53	556.04
S_2 (15 cm × 10 cm)	96.82	97.54	97.18	3.32	3.64	3.48	0.0216	0.0237	0.0227	0.050	0.055	0.052	566.51	567.58	567.04
S_3 (15 cm × 12.5 cm)	98.62	100.32	99.47	2.93	3.26	3.10	0.0238	0.0266	0.0252	0.055	0.061	0.058	571.61	579.27	575.44
S_4 (15 cm × 15 cm)	103.99	106.18	105.09	2.72	3.11	2.92	0.0266	0.0304	0.0285	0.061	0.070	0.066	575.79	587.29	581.54
S.Em±	1.37	0.74	0.78	0.22	0.14	0.13	0.0015	0.0009	0.0009	0.003	0.002	0.002	4.70	4.68	3.32
C.D. at 5%	4.02	2.16	2.22	0.64	0.40	0.37	0.0043	0.0028	0.0025	0.010	0.006	0.006	13.78	13.72	9.45
Interaction (V×S)															
S.Em±	2.37	1.28	1.35	0.38	0.24	0.22	0.0025	0.0016	0.0015	0.006	0.004	0.003	8.14	8.10	5.74
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.V. %	4.18	2.22	3.34	20.43	11.63	16.55	19.38	11.25	15.44	19.379	11.25	15.44	2.49	2.45	2.47

Table 3: Effect of varieties and spacing on yield of onion

Treatments	Average bulb weight (g)			Marketable bulb yield (t ha^{-1})		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
Varieties (V)						
V_1 (GJRO-11)	81.11	83.94	82.52	34.35	38.28	36.32
V_2 (Agrifound Light Red)	74.71	77.54	76.12	33.81	37.43	35.62
V_3 (NHRDF Red-3)	86.94	89.78	88.36	34.74	38.68	36.71

S.Em±	2.03	2.03	1.43	0.16	0.18	0.12
C.D. at 5%	5.94	5.94	4.08	0.46	0.54	0.34
Spacing (S)						
S_1 (15 cm × 7.5 cm)	67.26	70.09	68.67	36.17	39.68	37.92
S_2 (15 cm × 10 cm)	76.08	78.92	77.50	34.62	38.76	36.69
S_3 (15 cm × 12.5 cm)	81.67	84.50	83.08	34.06	37.87	35.97
S_4 (15 cm × 15 cm)	98.67	101.50	100.08	32.36	36.21	34.28
S.Em±	2.34	2.34	1.65	0.18	0.21	0.14
C.D. at 5%	6.86	6.86	4.72	0.53	0.62	0.40
S.Em±	4.05	4.05	2.87	0.31	0.37	0.24
C.D. at 5%	11.89	11.89	8.17	0.91	1.08	0.69
C.V. %	8.68	8.38	8.53	1.57	1.67	1.63

Table 4: Combine effect of varieties and spacing on yield of onion

Treatments combinations	Average bulb weight (g)			Marketable bulb yield (t ha^{-1})		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
V_1S_1 (GJRO-11 and 15 cm × 7.5 cm)	71.04	73.87	72.45	35.84	39.70	37.77
V_1S_2 (GJRO-11 and 15 cm × 10 cm)	74.26	77.09	75.68	35.10	39.30	37.20
V_1S_3 (GJRO-11 and 15 cm × 12.5 cm)	77.89	80.73	79.31	33.94	37.75	35.84
V_1S_4 (GJRO-11 and 15 cm × 15 cm)	101.24	104.07	102.65	32.52	36.37	34.44
V_2S_1 (Agrifound Light Red and 15 cm × 7.5 cm)	57.33	60.17	58.75	36.33	39.43	37.88
V_2S_2 (Agrifound Light Red and 15 cm × 10 cm)	72.04	74.87	73.46	33.85	37.70	35.78
V_2S_3 (Agrifound Light Red and 15 cm × 12.5 cm)	84.60	87.43	86.02	34.05	37.83	35.94
V_2S_4 (Agrifound Light Red and 15 cm × 15 cm)	84.85	87.68	86.27	31.01	34.75	32.88
V_3S_1 (NHRDF Red-3and 15 cm × 7.5 cm)	73.40	76.23	74.82	36.33	39.90	38.12
V_3S_2 (NHRDF Red-3and 15 cm × 10 cm)	81.95	84.78	83.37	34.89	39.27	37.08
V_3S_3 (NHRDF Red-3 and 15 cm × 12.5 cm)	82.51	85.34	83.92	34.19	38.05	36.12
V_3S_4 (NHRDF Red-3 and 15 cm × 15 cm)	109.92	112.75	111.33	33.54	37.51	35.53
S.Em±	4.05	4.05	2.87	0.31	0.37	0.24
C.D. at 5%	11.89	11.89	8.17	0.91	1.08	0.69
C.V. %	8.68	8.38	8.53	1.57	1.67	1.63

Conclusions

From the results of two years study, it can be concluded that variety GJRO-11 had superior growth and physiological parameters over rest of varieties. Yield was found best in NHRDF Red-3. Among different spacing, 15 cm × 15 cm was superior in term of growth, physiological and average bulb weight. Whereas, marketable yield was found superior in plant spacing 15 cm × 7.5 cm. The treatment combination *i.e* NHRDF Red-3 with spacing 15 cm × 15 cm was found superior in terms of average bulb weight, while marketable bulb yield was superior in treatment combination of NHRDF Red-3 with plant spacing 15 cm × 7.5 cm.

References

1. Gupta RP, Srivastava KJ, Pandey UB, Midmore DJ. Disease and insect pest of onion in India. Acta Horticulturae. 1994;358:265-372.
2. Jilani SM, Ghaffoor A. Screening of local varieties of onion for bulb formation. International Journal of Agriculture & Biology. 2003;5(2):129-133.
3. Khan MA, Hasan MK, Miah MA, Alam MM, Masum AS. Effect of plant spacing on the growth and yield of different varieties of onion. Pakistan Journal of Biological Sciences. 2003;6(18):1582-1585.
4. Kishor S, Ram RB, Sachin K, Meena ML, Satyendra K. Effect of spacing and different cultivars on growth and yield of onion (*Allium cepa* L.) under Lucknow conditions. International of Pure & Applied Bioscience. 2017;5(4):612-616.
5. Manach C, Williamson G, Morand C, Scalbert A, Remesy C. Bioavailability and bioefficacy of polyphenols in humans. The American Journal of Clinical Nutrition. 2005;81:230-242.
6. Maurya SK, Verma RS, Pal H, Samiksha A, Prakash S, Kumar V, *et al*. Effect of spacing and varieties on growth attributes of rabi onion (*Allium cepa* L.). The Pharma Innovation Journal. 2019;8(8):21-23.
7. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers, ICAR Publications, New Delhi, India, 1985, 155pp.
8. Singh HM, Singh S. Effect of different spacing and transplanting dates on growth and yield of onion (*Allium cepa* L.) var. Agrifound Light Red. Journal of Agri Search. 2019;6:64-67.
9. Singh RK, Bhonde SR. Performance studies of exotic onion (*Allium cepa* L.) hybrids in the Nashik region of Maharashtra. Indian Journal of Hill Farming. 2011;24(2):29-31.