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Growth and seed yield of onion (*Allium cepa* L.) cv. Sukhsagar as influenced by different sowing spacing of bulbs

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Abstract

A study "Growth and seed yield of onion (*Allium cepa* L.) cv. Sukhsagar as influenced by different sowing spacing of bulbs" was conducted in the Horticultural Research farm of Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, which is situated at 23°5' N latitude and 80°02' E longitudes with an elevation of 9.75 meter from the sea level and a distance of about 100 km in north of the capital city of West Bengal, Kolkata having well connected with road (NH-34) during the year 2016 to 2017. The purpose of the study was to evaluate the effect of different sowing spacing of onion bulbs on plant growth and quality seed production of onion. Onion variety "Sukhsagar Local" with three different sowing spacing (S1 : 30 cm x 30 cm, S2 : 40 cm x 30 cm, S3 : 50 cm x 30 cm) had a remarkable impact on seed yield, yield attributes and seed quality. Plant height, number of leaves per plant, length of scape, number of umbels per plant, umbel diameter, seed yield per plant, germination percentage and electrical conductivity were positively influenced by bulb size of onion. It was revealed that the wider spacing of 50 x 30 cm gave larger numbers of umbels per plant than the umbels sown closer (30 x 30 cm) and medium (40 x 30 cm) ones. Closer bulbs gave lowest umbel diameter with smaller inflorescences than the medium and wider planted ones. The bulb size also did not affect seed yield per one seed stalk, but it did affect the seed yield obtained from the entire plant, which was bigger for plants grown from wider planted bulbs in comparison with the closer ones. Bulb spacing showed significant effects on growth and yield. Thus, as closer planted, the number of flower stalks per bulb decreased, as did in seed production per plant and per hectare. The closer planting (30 x 30 cm) gave the highest net return with a maximum benefit cost ratio.

Keywords: bulb, onion, planting spacing, west bengal

Introduction

India is the second largest producer of onion bulbs in the world in an area of 1225 thousand ha with production of 20991 thousands MT and productivity of 16.03 t/ha (NHB, 2015-16). The four major onion growing countries are China, India, USA and Turkey. The other important countries for onion cultivation are Iran, Italy, Egypt, Netherlands, Russia, Thailand, Indonesia, Korea, Japan and Brazil. India ranks second in area and production in the world after China. In India, the important states for onion production are Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh, Gujarat, Punjab, Haryana, Rajasthan, Uttar Pradesh, Bihar and Madhya Pradesh. Maharashtra is the leading state with 457 thousand ha area and 5654 thousand MT production followed by Karnataka. In West Bengal onion is cultivated over an area of 25.31 thousand ha, production of 369.20 thousand MT with productivity of 14.59 t/ha. (NHB, 2015-16). In West Bengal, the picture in relation to the area and production of onion not very much clear and satisfactory. The onion is cultivated only in small pocket in marginal scale, which is utilized for local consumption and cannot meet of the increasing demand of huge population in West Bengal. There is immense scope to increase area and production of this crop in West Bengal by cultivating the crop as bulb purpose as well as seed production. Hence there is great need of standardizing the efficient technology for production of good quality onion seed with higher yield per unit of area. Still, there is a big gap between demand and supply because of meager production due to poor cultural package of practices followed by the farmers for the production of onion seed. Considering the above facts in view, the field experiments entitled "Growth and seed yield of onion (*Allium cepa* L.) cv. Sukhsagar as influenced by spacing of bulbs" has been conducted.

Jilani *et al.*, (2010) [9] reported that lower planting density significantly increased the number of leaves per plant (13.82) in onion. Asaduzzaman *et al.*, (2012b) [5] reported that crop planted at 30x20 cm spacing resulted in maximum number of flowering stalks per plant (3.43),

length of flowering stalk (83.25 cm), number of umbels per plant (3.42), number of seeds per umbel (227.17), seed weight per umbel (0.76 g) and test weight (3.56 g) as compared to 25 x 15 cm plant spacing. Kumar *et al.*, (2013) obtained the maximum plant height (49.55 cm), number of leaves (16.93), length of leaves (48.33 cm), diameter of longest leaf (1.61 cm) and bulb yield (313.74 kg/ha) from the crop planted at 18 x 12 cm plant spacing. Elliag and Osman (2014a) recorded the minimum number of days to 50 flowering (68.3 days) where the crop planted at wider spacing. Singh and Ahmed (2005) ^[15] reported that onion crop planted at 30 x 10 cm plant spacing resulted in maximum plant height (98.68 cm), while the crop planted at 30 x 20 cm plant spacing resulted in maximum number of sprouts per hill (5.53), number of umbellate (195.71), number of seeds per umbel (751.31), seed yield per hectare (1020 kg) and seed germination percentage (74.81).

Mahadeen (2004) ^[11] reported that onion crop planted at wider spacing resulted in highest seed yield per plant (16.27 g), seed germination percentage (88.40), test weight (3.42 g), seed vigour index-I (382.54) and seed vigour index-II (1175.62) while the crop planted at closer spacing resulted in highest seed yield per hectare (700 kg). Dudliat *et al.*, (2010) ^[6] recorded the highest seed yield (639.70 kg/ha) by planting the onion bulbs at 30x30 cm plant spacing. Mirshekari and Mobasher (2006) ^[12], reported that bulb size and plant spacing are the key factors in producing quality onion seeds. Wider spacing recorded the significantly maximum in growth attributes but maximum yield per hectare was recorded in narrow spacing (301.06 q).

Methos and Materials

A research trial was conducted at the Horticultural Research Station, Mondouri Farm, BCKV, Mohanpur, Nadia, West Bengal, India during 2016 to 2017. The main objectives of the trial were to find out the performance of onion variety of Sukhsagar. The bulbs of uniform sizes on visual observations were selected on flat bed system. The experiment was designed as Randomizes Complete Block Design (RCBD) with comprising of 9 treatment combinations in a single replication. To minimize the experimental errors, these treatment combinations were replicated three times. The plot size was kept 2.1 m × 1.8 m for each treatment. The bulbs were planted on three different spacing of S1: 30 cm x 30 cm, S2: 40 cm x 30 cm, S3 : 50 cm x 30 cm in the year of 2016. The experimental site is situated in the sub tropical region. Broadly the seasons are classified as i) Summer (March-May) ii) Rainy (June-Oct.) iii) Winter (Nov.-Feb.). The monthly mean maximum temperature does not exceed 37.9°C in May and minimum temperature does not fall below 8.5°C in January. The average rainfall about 1500 mm is mostly received during July-Sept. Relative humidity ranges from 55-99% in different seasons. Well rotten farmyard manure (FYM) at the rate of 40 t/ha was incorporated to the soil 7 days before planting the bulbs. The recommended dose of NPK fertilizes was applied at a ratio of 120- 60-60 kg/ha. All the Phosphorous, Potash and half dose of Nitrogen was applied at the time of planting the seedlings while the remaining half dose of Nitrogen was applied after 30 days. All the cultural and management practices like hoeing, weeding, irrigation and sprays for insect pests and disease control etc were carried out uniformly for all treatments.

Data on number of leaves/plant, leaf length (cm), number of scapes/plant, scapes length (cm), height of the plant (cm), test weight of 1000 seeds, germination percentage of seeds,

number of umbel and it's diameter, Yield attributes (per plant, per plot, total yield per ha), were collected and analysis done on the basis of research.

Results and Discussion

Height of the plant (cm), Number of leaves per plant, Length of leaves (cm), Number of scapes (per plant), Length of Scapes (cm)

The height of plant affected on spacing of the plant. Significant height was observed with increase in spacing (Table I). The maximum height of 51.20 cm was obtained from wider spacing of 50 x 30 cm and the minimum height (48.78cm) was obtained in closer spacing of 30 x 30 cm. More plant height at wider spacing might be due to more space for lateral growth and less competition to get more light. This findings are in good agreement with the findings of Ambulkar *et al.* (1995) ^[2].

plant spacing also had a significant effect on the number of leaves per plant (Table I). With increasing spacing there was significant increase in the number of leaves per plant. It was observed that the maximum number of leaves per plant (23.89) was observed when spacing S3 50 x 30 cm. The increasing leaf number with more spacing might be due to the possibility of higher stored food, nutrients, minerals present in soil and more space to root growth. The result was in conformity with the report of Rudolah (1988) ^[14].

The treatment variation due to different spacing was also significant. Highest length of leaves (33.59 cm) were noticed in wider (50 x 30 cm) spacing. However, minimum length of leaves (32.74 cm) was recorded both in closer (30 x 30 cm) spacing and medium (40 x 30 cm) spacing. This might be presence of more moisture availability and less competition of nutrition availability between the plants. The result signifies with the report of Hwang *et al.* (1996) ^[8].

Increase in number of scapes per plant with increase in plant spacing was significantly higher at 50 x 30 cm spacing, compared with 40 x 30 cm and 30 x 30 cm (Table I). The highest (3.85) number of scapes was obtained when spacing was increase from 30 x 30 cm to 50 x 30 cm. However the value obtained at 40 x 30 cm (3.78) at par with wider spacing (3.85). The trend of effect of spacing on number of scapes is in agreement with the finding of Singh and Ahmed (2005) ^[15]. It is evident from Table I that, the height of the scapes was significantly influenced by spacing. The height of the scapes were recorded highest (76.22 cm) under the spacing 50 x 30 cm (S3) followed by S2 (74.21 cm) and S1 (73.37 cm) respectively. similar result was also reported by Tiwari *et al.* (2002) ^[17].

Number of umbel (per plant), diameter of umbel (cm), test weight of 1000 seeds and germination percentage (%)

The total number of umbels per plant was also significantly influenced by spacing. The maximum number of umbels per plant (3.81) was observed at 50 x 30 cm of wider spacing. However, the minimum (3.67) was obtained with closest spacing of 30 x 30 cm. The wider spacing was responsible for more number of umbels per plant. It may be due to the fact that bulbs planted at wider spacing received judicious supply of mineral nutrients and light exposure had ultimately resulted in great number of umbels.

Variation in spacing had significant effect on the diameter of umbel. Diameter of umbel had an increasing trend with each increasing in spacing (Table II). The highest (7.19 cm) was recorded in 50 x 30 cm spacing which was significantly higher in comparing to 40 x 30 cm (6.98 cm) and 30 x 30 cm

spacing (6.79 cm) respectively. This may be due to the availability of ample space and nutrient at the wider spacing which favoured the expansion of umbel size and development of plant.

Wider spacing improved the growth of the plant and which in turn supplied better nutrition for the development of the seeds. As a result (Table II), weight of 1000 seed was significantly influenced with spacing. it was minimum (3.39 g) with medium spacing but maximum (3.50 g) with wider spacing. This might be due to the bold sized of the seeds at wider spacing with proper availability of nutrients. This observation was not corroborated with the finding of Amiroddin *et al.*(1988), where the maximum 1000 seed weight (3.679 g) was recorded with intermediate spacing of 20 cm. But the results signified with the report of Ali *et al.* (1998) [1].

The results showed that the lowest (84.77%) and the highest (86.67%) mean seed germination percentage was recorded at 40 x 30 cm and 50 x 30 cm spacing respectively (Table II). This results are in conformity with the work of Asaduzzaman *et al.*(2012) [4] who reported that wider intra row spacing had a significant effect on seed germination percentage.

Seed yield per plant (gm), Seed yield per plot (gm) and Total yield per hectare (kg)

The seed yield per plant (Table III) was influenced significantly with increased in spacing. It was observed that boosting positive effect was found with each increase in plant spacing. The seed yield per plant increase linearly as the spacing was increased from closer to wider. The seed yield was maximum (12.97 g/plant) in the treatment where wider spacing (50 x 30 cm) were taken.

While presenting the results of experiment in connection with the seed yield per plot, it was observed that maximum 316.54 g seed was obtained with the first level of spacing (30 x 30 cm). Seed yield per plot with this spacing is positively related with the higher population density per unit area. There was a great variation of 20.27% on seed yield per plot which was higher under 30 x 30 cm over 50 x 30 cm spacing.

The response of seed yield was statistically varied by different plant spacing (Table III). It was further revealed that seed yield was increased significantly with closer spacing of 30 x 30 cm. The highest seed yields of 854.28 kg per hectare were obtained when the bulb was planted at closer spacing. This might be due to the fact that higher plant populations were

available with minimum spacing resulting the highest seed yield. The result obtained here was in conformity with the findings of Singh and Sachan (1999) [16], who recorded the maximum seed yield of 14.28 q/ha with closer spacing of 30 x 15 cm.

Conclusion and Recommendation

It was observed that among different levels of spacing the closest spacing of 30 x 30 cm was significant influence on some growth parameters like height of the plant, length of leaves, height of scapes, days to 50% flowering, seed weight per plot and seed yield per hectare. It is apparent from the study that plant with closer spacing was superior to obtained highest seed weight of 316.54 g per plot and seed yield of 854.28 kg per hectare respectively. On the other hand, yield attributing characters like number of leaves per plant, number of scapes per plant, diameter of scape (cm), number of umbels per plant, diameter of umbel (cm), days to 50% flowering, 1000 seed weight (g) and seed weight per plant (g) were influenced significantly with further increasing the levels of spacing. The plant with wider spacing producing the maximum length of leaves of (33.59 cm), diameter of scapes (2.16 cm), Scapes number per plant (3.85) and seed weight per plant (12.97 g) which was greater to other spacing treatment.

Considering the overall performance in relation to the spacing it led to a conclusion that for obtaining higher seed yield of onion, closer spacing may be advised to practiced in the Gangetic plains of West Bengal. However the results should be carried out for atleast 2-3 years to confirm the results. There is ample scope for further research on this crop, which remains uninvestigated in the present experiment. So, further following investigation need to be carried out which will be of immense practical value. Investigation may be under taken to standardize the time of planting with observation of onion under Gangetic Alluvial Zone of West Bengal. The present work may be substained by studying the effect of temperature, relative humidity, light intensity and day length on the growth and seed yield under West Bengal condition. The method, optimum dose and time of application of organic and inorganic fertilizer to increase the seed yield may also be studied. To improve the quality of seed, different method applied for seed production need to be studied.

Table I: Effect of spacing of bulbs on onion varieties of Sukhsagar for height of plant (cm), number of leaves, leaf length (cm), number of scapes and length of scapes (cm)

Spacing	Height of Plant (cm)			Mean	Spacing	Number of leaves/plant			Mean
30 x 30 cm	53.37	51.34	41.62	48.78	30 x 30 cm	25.6	22.84	19.42	22.62
40 x 30 cm	54.36	51.38	43.41	49.72	40 x 30 cm	26.44	23.28	20.24	23.32
50 x 30 cm	55.84	52.68	45.09	51.2	50 x 30 cm	27.08	23.84	20.76	23.89
	CD (5%)		SEm (±)				CD (5%)	SEm (±)	
	Factor (S)	1.44	0.48			Factor (S)	0.86	0.28	

Spacing	Length of Leaves(cm)			Mean	Spacing	No. Of scapes			Mean
30 x 30 cm	35.59	33.15	29.49	32.74	30 x 30 cm	4.03	3.77	2.67	3.49
40 x 30 cm	36.47	32.46	29.27	32.74	40 x 30 cm	4.07	3.62	3.64	3.78
50 x 30 cm	37.19	33.5	30.08	33.59	50 x 30 cm	4.58	3.71	3.25	3.85
		CD (5%)	SEm (±)				CD (5%)	SEm (±)	
	Factors	1.76	0.82			Factors	0.42	0.15	

Spacing	Length of scapes (cm)			Mean
30 x 30 cm	79.3	73.56	67.26	73.37
40 x 30 cm	78.82	75.82	67.99	74.21
50 x 30 cm	80.3	77.96	70.39	76.22
		CD (5%)	SEm (±)	
	Factors	0.74	0.245	

Table II: Effect of spacing of bulbs on onion variety of Sukhsagar for number of umbel per plant, umbel diameter (cm), test weight (g) and germination percentage (%).

Spacing	No. Of umbel/plant				Spacing	Diameter of umbel (cm)			
				Mean					Mean
30 x 30 cm	4.45	3.46	3.11	3.67	30 x 30 cm	8.01	6.4	5.97	6.79
40 x 30 cm	4.34	3.68	3.21	3.75	40 x 30 cm	7.97	6.67	6.3	6.98
50 x 30 cm	4.47	3.75	3.21	3.81	50 x 30 cm	8.03	7.02	6.53	7.19
		CD (5%)	SEm (±)				CD (5%)	SEm (±)	
	Factor (S)	0.14	0.18			Factor (S)	0.28	0.09	

Spacing	Test weight (g)				Spacing	Germination percentage			
				Mean					Mean
30 x 30 cm	3.57	3.47	3.23	3.43	30 x 30 cm	89.22	85.85	82.59	85.89
40 x 30 cm	3.63	3.42	3.13	3.39	40 x 30 cm	87.23	86.13	80.94	84.77
50 x 30 cm	3.72	3.49	3.29	3.5	50 x 30 cm	91.41	86.93	81.67	86.67
		CD (5%)	SEm (±)				C.D. (5%)	SEm (±)	
	Factor (S)	0.13	0.04			Factor (B)	1.25	2.4	

Table III: Effect of spacing of bulbs on onion varieties of Sukhsagar for Seed yield per plant (gm), Seed yield per plot (gm) and total seed yield per ha (Kg).

Spacing	Seed yield/plant				Spacing	Seed yield/plot			
				Mean					Mean
30 x 30 cm	15.02	12.15	9.44	12.2	30 x 30 cm	373.08	313.09	263.45	316.54
40 x 30 cm	14.97	12.03	10.73	12.58	40 x 30 cm	267.85	262.42	206.68	245.65
50 x 30 cm	15.16	12.95	10.8	12.97	50 x 30 cm	246.91	236.83	197.49	227.08
		CD (5%)	SEm (±)				CD (5%)	SEm (±)	
	Factor(S)	0.25	0.88			Factor (S)	16.09	5.32	

Spacing	Total Seed Yield/ha(Kg)			Mean
30 x 30 cm	1,006.72			854.28
40 x 30 cm	722.77			662.86
50 x 30 cm	666.27			612.75
		CD (5%)	SEm (±)	
	Factor (S)	43.69	14.45	

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