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Effect of planting layout and plant spacing on growth and yield of bulb production (*kharif*) of onion (*Allium cepa* L.)

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Abstract
A field experiment on "Effect of planting layout and plant spacing on growth and yield of bulb production (*Kharif*) and seed production (*Rabi*) of onion (*Allium cepa* L.)" was carried out at Post Graduate Institute Research Farm, Mahatma Phule Krishi Vidyapeeth, Rahuri (M.S.) with a view to study the growth and yield of onion bulb production under different level of planting layout and plant spacing during *Kharif* season, 2015-16 and 2016-17. The experiment was laid out in factorial randomized block design with three replications. For the bulb production in *Kharif* the treatments consisted of four planting layout viz., check basin (L_1), ridges and furrow (L_2), raised bed (L_3) and farmer practice (L_4) (Border strip) and two plant spacing viz., 30 x 10 cm (S_1) and 20 x 10 cm (S_2). Planting layout of ridges & furrow (L_2) exhibited significantly higher yield and yield attributes like equatorial diameter of onion bulb production (*Kharif*) (4.94 and 4.74 cm), polar diameter (5.95 and 5.78 cm) and average weight of bulb (80.33 and 77.66 g) at harvesting stage which was at par with planting layout of raised bed (L_3) in respect of yield attributes like equatorial diameter (4.89 and 5.70 cm), polar diameter (5.87 and 5.70 cm) and average weight of bulb (78.50 and 75.83 g) both the year respectively. Bulb shape index (0.83 and 0.82) was significantly less in case of planting layout ridges & furrow (L_2) as compared to the other planting layout. Planting layout of ridges & furrow (L_2) exhibited significantly higher marketable bulb yield of onion bulb production (*Kharif*) (305.00 and 300.37 q ha^{-1}), leaves yield (12.16 and 11.53 q ha^{-1}) and harvest index (96.21 and 96.35) both the year respectively. Plant spacing of 20 x 10 cm (S_2) exhibited significantly higher marketable bulb yield of onion bulb production (*Kharif*) (306.75 and 302.02 q ha^{-1}), leaves yield (14.11 and 13.36 q ha^{-1}) and exhibited significantly lower harvest index (95.60 and 95.68) both the year respectively. For the bulb production of onion planting layout of ridges and furrow (L_2) along with plant spacing of 20 x 10 cm (S_2) is suitable for achieving maximum growth, marketable bulb yield.

Keywords: Planting Layout, Plant Spacing, Check Basin, Ridges & Furrow, Raised Bed and Farmer Practice

Introduction
Onion (*Allium cepa* L.) belongs to the family Amaryllidaceae (amaryllis) or liliaceae and is one of the most important monocotyledonous, cross-pollinated and cool season vegetable crops. It originated in Afghanistan, Tajikistan and Uzbekistan, Western Tien Shan India, western Asia and the area around the Mediterranean Sea. Onion is considerably important in the daily Indian diet. All the plant parts are edible, but the bulbs and the lower stem sections are the most popular as seasonings or as vegetables in stews (MoARD, 2006) [5]. It is one of the richest sources of flavonoids in the human diet which is relevant given that the flavonoid consumption has been associated with a reduced risk of cancer, heart disease and diabetes. Flavonoids are not only anti-cancer, but also are known to be anti-bacterial, antiviral, antiallergenic and anti-inflammatory. Some of the reasons behind low productivity in India include poor irrigation facilities, use of local variety seeds, small land holding, indigenous agronomic practices and poor economic background of farmers, lack of use of improved method of cultivation, less use of chemical fertilizers and pesticide, higher post-harvest losses and absence of good scientific storage facilities. There is a scope for increasing onion productivity through following appropriate land configuration, cultivars and agronomic practices (Mondal *et al*. 1986; Mondal, 1991) [6, 7]. To increase the per hectare yield of onion, emphasis must be given on adopting improved varieties, plant spacing, depth of planting and other cultural measures. Several researchers in many countries have shown that varieties and

plant spacing had profound effects on the growth and yield of onion (Bhonden *et al.* 1995) [3]. Successful bulb production depends on the plant spacing. Spacing affects the plant growth, size of bulb, yield as well as the quality of the onion planting at proper spacing increases the quality and size of bulb (Nichols and Heydecker, 1964) [10]. Many workers reported that wider spacing caused higher yield per plant, although the closer spacing gave higher yield per unit area due to increased plant density up to a certain limit (Nehra *et al.* 1988). Depth of planting of bulb is an important consideration in the production of onion. The depth of planting depends on varieties, bulb size, depth of ploughed layer, moisture content of the soil and climatic conditions. It also influence the emergence period. Although some production technologies are developed in the country, it is very difficult to give general recommendation that can be applicable to the different agro-ecological zones. To optimize onion productivity, full package of information is required. Plant population needs to be optimized. The optimum use of spacing or plant population has dual advantages. It avoids strong competition between plants for growth factors such as water, nutrient and light. In addition optimum plant population enables efficient use of available cropland without wastage. Lack of proper agronomic practice used by farmers is one of the major problems in onion production. This is because there had been no agronomic or varietal trial done for onion so far. The nationally recommended spacing between plants of onion has been 10 cm, which was based on the research done in central rift valley of the country some years back. Nevertheless, in the real situation, the practice, which is adopted by farmers, is as it far (narrower or wider) from the recommendation. There is no recommendation made even in the region with regard to onion plant spacing. *Kharif* onion bulb production is a peculiarity of Maharashtra state in the country. However, the major constraints in *kharif* onion cultivation are lower bulb productivity, high cost of production, lower quality of fresh, stored bulbs, unstable prices etc. Furthermore, high risk of disease and pest occurrences, weed management, long spells of either dry period or cloudy days (*i.e.* varied climatic conditions) are principle parameters which often makes *kharif* onion production more instable. Especially in context of climate change and price instability, the severity of problems is increased by manifolds. To overcome all these parameters and to improve the productivity and profitability of *kharif* onion bulb and *Rabi* seed crops the present investigation "Effect of planting layout and plant spacing on growth and yield of bulb production (*Kharif*) and seed production (*Rabi*) of onion (*Allium cepa* L.)" was undertaken.

Material and Methods

The experiment was carried out in the plot having survey No. 134/2 during the first year 2015-16 and in survey No. 134/4 for second year 2016-17 at Post Graduate Research Farm, Department of Agronomy, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar district (Maharashtra) which are situated at 19^0 21' N latitude and 74^0 38' E longitude and on altitude of about 436 meters above the mean sea level (MSL). The experiment was laid out in factorial randomized block design with three replications. For the bulb production in *Kharif* the treatments consisted of four planting layout viz., check basin (L_1), ridges and furrow (L_2), raised bed (L_3) and farmer practice (L_4) (Border strip) and two plant spacing viz., 30 x 10 cm (S_1) and 20 x 10 cm (S_2). Onion seeds are sown on nursery beds to raise seedlings for transplanting in the field. Raised beds of size 3 x 0.9 m and 10-15 cm in height are prepared. About 30 cm distance is kept between two beds to carry out operations of watering, weeding, etc. The surface of beds smooth and well levelled. Raised beds are necessary to avoid problem of water logging in heavy soils. Before going to sow the seed was treated with thirum 3 gm kg^{-1} seed. Ten bed are prepared and line sowing is done with 10 cm distance kept between rows. One kg of seed sown uniformly in raised bed. For avoidance of mortality of seedlings due to damping off, drenching of the beds was done with Carbendazim (15-20 g/10 liters of water). Healthy seedlings of onion cv. Phule Samarth were taken from the nursery having uniform growth of about 20-25 cm height and of 45 days of age old. Transplanting was done on 14th July and 17th February during the year 2015 and 2016, respectively. The healthy seedlings having uniform neck thickness and almost equal heights were selected and deep in starter solution with ration of 1:3:1 percent NPK and was planted according to the spacing as per treatment and plan of layout. Due care was taken to keep rhizosphere sufficiently moist in order to ensure proper establishment of plants up to 15 days. The treatments were imposed thereafter.

Results and Discussion

Effect of plant and spacing on growth parameters of onion bulb production

Plant Height (cm)

Significantly more height at all the stages of crop growth during both the years was recorded when crop was transplanted on ridges and furrow (L_2). However, it was at par with raised bed (L_3) at 28, 56, 84 and at harvest DAT during the year 2015-16 and at 28, 56, 84 and at harvest DAT during 2016-17 year. Plant spacing of 20 x 10 cm (S_2) registered significantly higher periodical plant height at all the crop growth stages during both years.

Pseudo Stem Diameter (cm)

Significantly more pseudo stem diameter of onion at all the stages of crop growth during both the years was recorded when crop was transplanted in ridges and furrow (L_2). Plant spacing of 30 x 10 (S_1) cm registered significantly higher pseudo stem diameter at all the crop growth stages during both years. Significantly minimum pseudo stem diameter was recorded under treatments 20 x 10 cm (S_2) at all the crop growth stages during both the years.

Number of Functional Leaves

Significantly more number of functional leaves $plant^{-1}$ at all the stages of crop growth during both the years was recorded when crop was transplanted in ridges and furrow (L_2). Plant spacing of 30 x 10 cm (S_1) registered significantly higher periodical number of functional leaves $plant^{-1}$ at all the crop growth stages during both years.

Number of Root

The number of root $plant^{-1}$ was influenced significantly due to the different planting layout levels. Significantly more number of root $plant^{-1}$ of onion at all the stages of crop growth during both the years was recorded when crop was transplanted in ridges and furrow (L_2). Plant spacing of 30 x 10 cm (S_1) registered significantly higher number of root $plant^{-1}$ at all the crop growth stages during both years.

Dry Matter $Plant^{-1}$ (g)

Significantly more dry matter $plant^{-1}$ (g) of onion at all the stages of crop growth during both the years was recorded

when crop was transplanted in ridges and furrow (L_2). The dry matter plant^{-1} (g) of onion was influenced significantly due to the different plant spacing levels. Plant spacing of 30 x 10 cm (S_1) registered significantly higher dry matter plant^{-1} (g) at all the crop growth stages during both years.

Effect of plant and spacing on yield parameters of onion bulb production

Equatorial Diameter (cm)

The equatorial diameter (cm) was influenced significantly due to the different planting layout levels. Significantly higher equatorial diameter (cm) of onion at harvest during both the years was recorded when crop was transplanted in ridges and furrow (L_2). Plant spacing of 30 x 10 cm (S_1) registered significantly higher equatorial diameter (cm) at harvest during both years. Significantly minimum equatorial diameter (cm) of onion was recorded under treatments 20 x 10 cm (S_2) at harvest during both the years.

Polar Diameter (cm)

The polar diameter (cm) was influenced significantly due to the different planting layout levels. Planting layout levels of ridges and furrow (L_2) recorded significantly maximum polar diameter (cm) (5.95) than check basin (L_1) and farmer practice (L_4) (5.48 and 5.36), but it was at par with raised bed (L_3) (5.87) during the year 2015-16. Plant spacing of 30 x 10 cm (S_1) recorded significantly higher polar diameter (cm) (6.04 and 5.87) than plant spacing of 20 x 10 cm (S_2) (5.24 and 5.07) during both the years respectively.

Shape Index

The shape index was influenced significantly due to the different planting layout levels. Planting layout levels of raised bed (L_3) recorded significantly maximum shape index (0.83) than check basin (L_1) and farmer practice (L_4) (0.82 and 0.82), but it was at par with ridges and furrow (L_2) (0.83), check basin (L_1) (0.82), and farmer practice (L_4) (0.82) during the year 2015-16. Plant spacing of 20 x 10 cm (S_2) recorded significantly higher shape index (0.84 and 0.83) than plant spacing of 30 x 10 cm (S_1) (0.81 and 0.80) during both the years respectively.

Average Weight of Bulb (g)

The average weight of bulb (g) was influenced significantly due to the different planting layout levels. Planting layout levels of ridges and furrow (L_2) recorded significantly maximum average weight of bulb (g) (80.33) than check basin (L_1) and farmer practice (L_4) (76.00 and 73.83), but it was at par with raised bed (L_3) (78.50) during the year 2015-16. Plant spacing of 30 x 10 cm (S_1) recorded significantly higher average weight of bulb (g) (80.92 and 78.25) than plant spacing of 20 x 10 cm (S_2) (73.42 and 70.75) during both the years respectively.

Marketable Bulb Yield (q ha^{-1})

The marketable bulb yield of onion (q ha^{-1}) was influenced significantly due to the different planting layout levels. Planting layout levels of ridges and furrow (L_2) recorded significantly maximum total bulb yield of onion (q ha^{-1}) (305.00, 300.37 and 302.69 q ha^{-1}) than farmer practice (L_4) (277.50, 272.88 and 275.19 q ha^{-1}), during both the years and in pooled mean, respectively. Plant spacing of 20 x 10 cm (S2) recorded significantly higher marketable bulb yield (q ha-1) (306.75, 302.12 and 304.44 q ha-1) over 30 x 10 cm (S1), (272.50, 267.88 and 270.19 q ha-1) during both the years and in pooled mean, respectively.

Leaves Yield (q ha^{-1})

The total leaves yield of onion (q ha^{-1}) was influenced significantly due to the different planting layout levels. Planting layout levels of ridges and furrow (L_2) recorded significantly maximum leaves yield of onion (q ha^{-1}) (12.16, 11.53 and 11.85 q ha^{-1}) than farmer practice (L_4) (11.60, 10.97 and 11.29 q ha^{-1}), during both the years and in pooled mean, respectively. Plant spacing of 20 x 10 cm (S_2) recorded significantly higher leaves yield (q ha^{-1}) (14.11, 13.36 and 13.74 q ha^{-1}) over 30 x 10 cm (S_1), (9.57, 9.07 and 9.32 q ha^{-1}) during both the years and in pooled mean, respectively.

Harvest Index

The harvest index of onion was influenced significantly due to the different planting layout levels. Planting layout levels of ridges and furrow (L_2) recorded significantly higher harvest index of onion (96.21, 96.35 and 96.28) than farmer practice (L_4) (96.01, 96.16 and 96.08), during both the years and in pooled mean, respectively. Plant spacing of 30 x 10 cm (S_1) recorded significantly higher harvest index (96.60, 96.72 and 96.66) over 20 x 10 cm (S_2), (95.60, 95.76 and 95.68) during both the years and in pooled mean, respectively.

Effect of plant and spacing on Economics of onion bulb production

Cost of cultivation

Planting layout level of ridges and furrow (L_2) recorded numerically maximum cost of cultivation for onion crop (107533, 113797 and 110665 ₹ ha^{-1}) as compared to planting layout level of raised bed (L_3), (107258, 113522 and 110390 ₹ ha^{-1}), planting layout at check basin (L_1), (104509, 116555 and 110532 ₹ ha^{-1}) and planting layout at farmer practice (L_4), (104509, 110773 and 107641 ₹ ha^{-1}) during both the years and on pooled mean basis, respectively. The plant spacing levels of 20 x 10 cm (S_2) recorded numerically maximum cost of cultivation for onion (111915, 118875 and 115395 ₹ ha^{-1}) than plant sapcing levels of 30 x 10 cm (S^1), (99989, 108448 and 104229 ₹ ha^{-1}) during both the years and on mean basis, respectively.

Gross monetary returns

Planting layout at ridges and furrow (L^2) recorded significantly maximum gross monetary returns for onion crop (614404, 380014 and 497209 ₹ ha^{-1}) as compared to planting layout level of raised bed (L_3) (596599, 367897 and 482248 ₹ ha^{-1}) and planting layout at check basin (L_1), (567599, 351028 and 453114 ₹ ha^{-1}) and planting layout farmer practice (L_4), (560112, 347334 and 453723 ₹ ha^{-1}) during both the years pooled mean basis, respectively. The plant spacing of 20 x 10 cm (S_2) recorded significantly maximum gross monetary returns for onion crop (615989, 379454 and 497721 ₹ ha^{-1}) than plant spacing levels of 30 x 10 cm (S_1), (553368, 343683 and 448526 ₹ ha^{-1}) during both the years and in pooled mean basis, respectively.

Net monetary returns

The net monetary returns ₹ ha^{-1} of onion crop as influenced by different planting layout and plant spacing levels. The net monetary returns ₹ ha^{-1} of onion crop was influenced significantly due to the different planting layout levels. of ridges and furrow (L_2) recorded significantly maximum net monetary returns (506870, 266217 and 386544 ₹ ha^{-1}) as

compared to planting layout level of raised bed (S_3), (489341, 254375 and 371858 ₹ ha^{-1}) and planting layout level of check basin (463073, 234473 and 348781 ₹ ha^{-1}) and planting layout level of farmer practice (L_4) (455602, 236560 and 346081 ₹ ha^{-1}) during both the years and in pooled mean, respectively. The plant spacing of 20 x 10 cm (S_2) recorded significantly maximum net monetary returns for onion crop (504073, 260578 and 382326 ₹ ha^{-1}) than plant spacing levels of 30 x 10 cm (S_1), (453378, 235235 and 344306 ₹ ha^{-1}) during both the years and in pooled mean basis, respectively.

B:C ratio

The B: C ratio ha-1 of onion crop as influenced by different planting layout and plant spacing levels. Planting layout of ridges and furrow (L_2) recorded numerically maximum B: C ratio of onion crop (5.71, 3.34 and 4.52) as compared to planting layout applied at raised bed (L_3), (5.56, 3.24 and 4.40), planting layout level of check basin (L_1), (5.44, 3.01 and 4.22) followed by planting layout designed at farmer practice (5.36, 3.14 and 4.25) during both the years and on pooled mean basis, respectively. The plant spacing levels of 20 x 10 cm (S_2) recorded numerically maximum B: C ratio of onion crop (5.50, 3.19 and 4.35) than plant spacing levels of 30 x 10 cm (S_1), (5.53, 3.17 and 4.35) during first, second and pooled mean basis, respectively.

Conclusion

Based on two years of experimentation, it could be concluded that planting layout ridges and furrow (L2) with plant spacing of 20 x 10 cm (S2) was suitable for bulb production in Kharif season. For the bulb production of onion planting layout of ridges and furrow (L2) along with plant spacing of 20 x 10 cm (S2) is recommended for achieving maximum growth, marketable bulb yield, quality, net monetary returns and B: C ratio from onion crop transplanted during Kharif season.

Table 1; Effect of planting layout and plant spacing on growth attributing characters on onion bulb production (*kharif*) at harvest

Treatment	Plant height (cm)		Pseudo stem diameter (cm)		Number of functional leaves plant^{-1}		Number of root plant^{-1}		Dry matter (g plant^{-1})	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
A) Planting layouts										
L_1: Check basin	55.74	53.95	1.45	1.39	7.67	7.60	65.38	63.15	15.70	15.40
L_2: Ridges and furrow	58.41	56.62	1.24	1.18	8.33	8.26	72.88	70.65	16.67	17.01
L_3: Raised bed	56.42	54.63	1.34	1.28	8.00	7.93	69.38	67.15	16.15	16.01
L_4: Farmer practice	55.15	53.36	1.53	1.47	7.33	7.26	61.55	59.32	14.17	13.80
S Em ±	0.70	0.65	0.05	0.05	0.13	0.14	1.50	1.37	0.19	0.43
CD at 5%	2.10	1.95	0.16	0.14	0.39	0.44	4.50	4.15	0.59	1.32
B) Plant spacing										
S_1: 30 cm x 10 cm	54.35	52.56	1.58	1.52	8.50	8.43	73.88	71.65	17.32	17.42
S_2: 20 cm x 10 cm	58.51	56.72	1.20	1.14	7.17	7.10	60.71	58.48	14.02	13.69
S Em ±	0.43	0.45	0.07	0.03	0.12	0.10	1.11	0.97	0.14	0.31
CD at 5%	1.30	1.37	0.28	0.10	0.36	0.31	3.33	2.94	0.42	0.93
C) Interaction (L x S)										
S Em ±	0.98	0.90	0.09	0.07	0.33	0.20	2.11	1.94	0.28	0.61
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
General mean	56.43	54.64	1.39	1.33	7.83	7.76	67.30	65.07	15.67	15.56

Table 2: Effect of planting layout and plant spacing on yield attributing characters on onion bulb production (*kharif*) at harvest

Treatment	Equatorial diameter of bulb (cm)		Polar diameter of bulb (cm)		Bulb shape index		Average weight of bulb (g)	
	2015	2016	2015	2016	2015	2016	2015	2016
A) Planting layouts								
L_1: Check basin	4.46	4.26	5.48	5.31	0.82	0.80	76.00	73.33
L_2: Ridges and furrow	4.94	4.74	5.95	5.78	0.83	0.82	80.33	77.66
L_3: Raised bed	4.89	4.69	5.87	5.70	0.84	0.83	78.50	75.83
L_4: Farmer practice	4.30	4.10	5.26	5.09	0.82	0.80	73.83	71.16
S Em ±	0.12	0.13	0.12	0.12	0.03	0.02	0.63	0.61
CD at 5%	0.36	0.39	0.37	0.37	0.10	0.06	1.90	1.84
B) Plant spacing								
S_1: 30 cm x 10 cm	4.89	4.69	6.04	5.87	0.81	0.80	80.92	78.25
S_2: 20 cm x 10 cm	4.40	4.20	5.24	5.07	0.84	0.83	73.42	70.75
S Em ±	0.20	0.09	0.09	0.09	0.02	0.01	0.30	0.26
CD at 5%	0.60	0.28	0.26	0.26	0.07	0.04	0.90	0.80
C) Interaction (L x S)								
S Em ±	0.31	0.18	0.17	0.17	0.09	0.00	0.59	0.53
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS
General mean	4.65	4.45	5.64	5.47	0.83	0.81	77.17	74.50

Table 3: Marketable bulb yield, leaves yield and harvest index of bulb onion (*Kharif*) as influenced by different treatments

Treatment	Marketable bulb yield (q ha^{-1})			Leaves yield (q ha^{-1})			Harvest index		
	2015	2016	Pooled mean	2015	2016	Pooled mean	2015	2016	Pooled mean
A) Planting layouts									
L_1: Check basin	281.00	276.37	278.69	11.75	11.12	11.44	96.01	96.15	96.08
L_2: Ridges and furrow	305.00	300.37	302.69	12.16	11.53	11.85	96.21	96.35	96.28
L_3: Raised bed	295.00	290.37	292.69	11.87	11.24	11.55	96.16	96.30	96.23
L_4: Farmer practice	277.50	272.88	275.19	11.60	10.97	11.29	96.01	96.16	96.08
S Em ±	1.44	1.46	1.45	0.14	0.15	0.15	0.02	0.14	0.10
CD at 5%	4.38	4.43	4.05	0.42	0.45	0.44	0.07	0.42	0.30
B) Plant spacing									
S_1: 30 cm x 10 cm	272.50	267.88	270.19	9.57	9.07	9.32	96.60	96.72	96.66
S_2: 20 cm x 10 cm	306.75	302.12	304.44	14.11	13.36	13.74	95.60	95.76	95.68
S Em ±	1.02	1.03	1.02	0.11	0.10	0.10	0.02	0.10	0.07
CD at 5%	3.10	3.13	3.11	0.33	0.31	0.32	0.05	0.30	0.22
C) Interaction (L x S)									
S Em ±	2.04	2.06	2.05	0.20	0.20	0.42	0.03	0.20	0.29
CD at 5%	6.19	6.26	6.22	NS	NS	NS	NS	NS	NS
General mean	289.63	285.00	287.31	11.84	11.22	11.53	96.10	96.24	96.17

Table 4: Economics of onion bulb production (*Kharif*) as influenced by different treatment

Treatment	Gross monetary return (₹ ha^{-1})			Cost of cultivation at Total cost (₹ ha^{-1})			Net monetary return at total cost (₹ ha^{-1})			B:C at total cost		
	Kharif 2015	*Kharif* 2016	Pooled mean	*Kharif* 2015	*Kharif* 2016	Pooled mean	*Kharif* 2015	*Kharif* 2016	Pooled mean	*Kharif* 2015	*Kharif* 2016	Pooled mean
A) Planting layouts												
L_1: Check basin	567599	351028	459314	104509	116555	110532	463089	234473	348781	5.44	3.01	4.22
L_2: Ridges and furrow	614404	380014	497209	107533	113797	110665	506870	266217	386544	5.71	3.34	4.52
L_3: Raised bed	596599	367897	482248	107258	113522	110390	489341	254375	371858	5.56	3.24	4.40
L_4: Farmer practice	560112	347334	453723	104509	110773	107641	455602	236560	346081	5.36	3.14	4.25
S.E.±	47.66	43.64	3070.74	28.87	43.30	684.40	143.10	433.01	2986.67	0.04	0.01	0.03
CD at 5%	144.55	132.38	8895.57	87.56	131.34	1982.64	434.03	1313.41	8652.04	0.13	0.04	0.09
B) Plant spacing												
S_1: 30 cm x 10 cm	553368	343683	448526	99989	108448	104219	453378	235235	344306	5.53	3.17	4.35
S_2: 20 cm x 10 cm	615989	379454	497721	111915	118875	115395	504073	260578	382326	5.50	3.19	4.35
S.E.±	33.70	30.86	2171.34	20.41	30.62	483.95	101.18	306.19	2111.90	0.03	0.01	0.02
CD at 5%	102.21	93.61	6290.12	61.91	92.87	1401.94	306.91	928.72	6117.92	NS	NS	NS
C) Interaction (L x S)												
S.E.±	67.40	61.72	8685.35	40.82	61.24	1935.79	202.37	612.37	8447.58	0.06	0.02	0.09
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
General mean	584679	361568	946247	105952	113662	219615	478726	247906	726632	5.52	3.18	8.70

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