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Effect of varieties and transplanting dates on growth of *kharif* onion (*Allium cepa* L.)

Mahesh Rugi, Sharanya BR and SS Kushwah

Abstract
A field experiment was conducted at research farm of the Department of Vegetable Science, College of Horticulture, Mandsaur (M.P.) during *kharif* season of 2016 to find out the effect of transplanting dates and varieties of onion, suitable for *kharif* season in this region. The treatments comprising of two transplanting dates i.e., D1 (10th August) and D2 (25th August) and eight varieties *viz*., V1 (Arka Kalyan), V2 (Arka Bheem), V3 (Bhima Red), V4 (Bhima Raj), V5 (Bhima Super), V6 (Bhima Dark Red), V7 (Bhima Shubhra) and V8 (Agrifound Dark Red) were tested in a factorial randomized block design with three replications. The results revealed that the plant height, number of leaves, chlorophyll content increased up to 90 DAT. Fresh and dry weight of shoots increased up to 90 DAT followed by a reduction at harvest. There was a significant effect of transplanting dates on all the parameters studied. Transplanting date D2 (25th August) recorded maximum plant height, number of leaves, chlorophyll content, fresh weight and dry weight of shoot. Among the varieties, V8 (Agrifound Dark Red) and Combined effect of treatment D2V7 (Bhima Shubhra with 25th August transplanting) showed maximum plant height, number of leaves, fresh weight and dry weight of shoot.

Keywords: *Kharif* onion, varieties, transplanting dates, plant height, Number of leaves, chlorophyll content, fresh and dry weight of shoot

Introduction
Onion (*Allium cepa* L.) is one of the most important vegetable crops of the India from ancient time. It belongs to family Alliaceae. Other members belonging to the same family include garlic, leek, shallot and chive. The Allium genus contains 300 to 500 species that can be found throughout the Northern temperate region. *Allium cepa* L. is the most common onion used for bulb production.

It is the world's second most profitable vegetable crop, after tomato, and has become a vital component in every kitchen due to its distinct flavour, pungency, and culinary characteristics. (Mallor *et al.*, 2011) [6]. Green leaves, immature bulbs, and mature bulbs are eaten fresh as salads or used to season vegetables, soups, gravies, stews, and other meals in a variety of ways. It's one of the few multipurpose vegetable crops that can be stored for a long time and can withstand the hazards of rough handling, including long-distance transportation.

Onions are also useful for their nutritional and therapeutic properties. Per 100 g of edible portion, the bulb includes 86.8 g moisture, 11.0 g carbohydrates, 1.2 g protein, 0.6 g fibre, 0.4 g mineral, thiamine 0.08 mg, vitamin-C 11 mg, calcium 180 mg, phosphorus 50 mg, iron 0.7 mg, nicotinic acid 0.4 mg, and riboflavin 0.01 mg. The outstanding characteristic of onion is the pungency, which is due to volatile oil known as allyl- propyl- disulphide, as sulphur rich compound. It is used as a remedy for various diseases like dysentery, convulsions, headaches, hysterical fits, rheumatic pain, sore throat and malaria fever and as a fine demulcent to give relief in piles (Bose *et al*., 1993) [2].

Onion is generally grown as winter crop in India. Due to shortage of onion often from October onwards the market price rises to a great extent. *Kharif* onion played a crucial role to meet this demand-supply gap and thereby reducing the price-rise of onion (Mohanta and Mandal, 2014) [7]. The growth and yield of cultivated crop plants is mainly influenced by three principal factors *viz.*, genetic factors, environmental factor and crop management factor. The first factor involves various plant breeding techniques, second factor involves atmospheric temperature, humidity and day length and third factors involves cultural operations *viz*., planting, fertilizers, irrigation, plant protection, weed control etc. The role of these factors is influenced by Genetic- Environmental interaction of crop plant.

Planting time is one of important factor that greatly influence the growth and yield of onion

(Mohanta and Mandal, 2014) [7]. Bulbing is a combined effect of photoperiod and temperature at a given location (Singh *et al.* 2011) [11]. Transplanting dates of onion seedlings means the effect of edaphic factors and environmental conditions in large scale on growth, bulb yield and bulb quality, which differ widely from region to region. Thus, to determined the optimum transplanting dates have a vital role in maximizing growth and quality of onion (Kandil *et al*. 2013) [5].

Successful onion production depends on the selection of varieties that are adapted to different conditions imposed by specific environment. *Kharif* onion is an off-season cultivation of the crop for which standardization of varieties is of immense utility (Mohanty and Prusti, 2001) [8]. Onion is a highly photo-thermo sensitive crop having limited adaptation. Thus onion varieties need to be tested for their performance and stability in the specific environment (Sharma, 2009) [10].

There is a scarcity of information pertaining to suitable varieties of onion under Malwa region of Madhya Pradesh and their reciprocation with date of transplanting. This support the importance of conducting such studies to meet the ever growing demand for onion in domestic and international market.

Materials and Methods

A field experiment was conducted at research farm of the Department of Vegetable Science, College of Horticulture, Mandsaur (M.P.) during *kharif* season of 2016. Sixteen treatment combinations consisting of two transplanting dates i.e., D1 (10th August) and D2 (25th August) and eight varieties *viz*., V1 (Arka Kalyan), V2 (Arka Bheem), V3 (Bhima Red), V4 (Bhima Raj), V5 (Bhima Super), V6 (Bhima Dark Red), V7 (Bhima Shubhra) and V8 (Agrifound Dark Red) were tested in a factorial randomized block design with three replications. Healthy seedlings were transplanted on 4 x 0.9 meter raised bed at 15 x 10 cm spacing. The standard package of practices was adopted to raise the crop successfully. Data were recorded on growth parameter *viz*., Plant height, Number of leaves per plant, fresh and dry weight of shoot and chlorophyll content. For weighing the fresh weight of shoot five plants were randomly uprooted and their underground portion was removed and their weight was recorded. After taking the fresh weight, these shoots of the plants were dried in oven at 65 ºC temperature till constant weight and final weight was noted. Observations recorded at 30, 60, 90 days after transplanting.

Results and Discussion

Plant height

The data presented in Table 1 revealed significant effect of transplanting dates and varieties on plant height at all the stages. There was significant effect of transplanting dates on plant height at all the stages. Transplanting of onion seedlings at D_2 (25th August) recorded maximum plant height at all the stages and minimum plant height was observed in case of D_1 (10th August). The variety V_8 (Agrifound Dark Red) recorded maximum plant height at all the stages followed by V_7 (Bhima Shubhra) and V_5 (Bhima Super). Minimum plant height was observed in case of V_2 (Arka Bheem) at all the stages of plant growth. At 30 and 60 DAT V_8, V_7, V_5 and V_3 were at par. At 90 DAT the difference between V_8, V_7, V_5, V_3 and V_6 were non significant. The combined effect of transplanting dates and varieties showed non significant effect on plant height at all stages of growth.

Table 1: Effect of transplanting dates, varieties and their interaction on plant height (cm) per plant of *kharif* onion

Treatment	Plant height (cm)		
	30 DAT	60 DAT	90 DAT
Transplanting dates (D)			
D_1	30.14	43.16	51.05
D_2	33.26	45.30	53.57
S.Em ±	0.73	0.73	0.87
CD at 5%	2.12	2.12	2.51
Varieties (V)			
V_1	27.53	38.77	48.13
V_2	25.93	36.87	46.37
V_3	33.33	46.52	53.63
V_4	29.77	44.33	51.40
V_5	34.00	46.88	54.87
V_6	32.07	43.80	52.10
V_7	34.08	47.37	55.23
V_8	36.88	49.33	56.73
S.Em ±	1.47	1.47	1.74
CD at 5%	4.24	4.24	5.03
Interaction (D x V)			
D_1V_1	26.53	35.60	46.47
D_1V_2	26.60	39.27	48.40
D_1V_3	31.47	45.90	52.33
D_1V_4	28.73	44.00	50.53
D_1V_5	31.93	46.20	54.13
D_1V_6	28.40	40.27	48.73
D_1V_7	30.47	44.40	51.00
D_1V_8	37.00	49.67	56.80
D_2V_1	28.53	41.93	49.80
D_2V_2	25.27	34.47	44.33
D_2V_3	35.20	47.13	54.93
D_2V_4	30.80	44.67	52.27
D_2V_5	36.07	47.57	55.60
D_2V_6	35.73	47.33	55.47
D_2V_7	37.70	50.33	59.47
D_2V_8	36.77	49.00	56.67
S.Em ±	2.08	2.08	2.46
CD at 5%	NS	NS	NS

Number of leaves: The data presented in Table 2 revealed significant effect of transplanting dates and varieties on plant height at all the stages. Transplanting of onion seedling at D_2 (25th August) recorded maximum number of leaves at all the stages of growth and minimum number of leaves was observed in case of transplanting on D_1 (10th August). The difference between D_2 (25th August) and D_1 (10th August) was significant at all stages of plant growth under study. Maximum number of leaves were recorded with variety V_8 (Agrifound Dark Red) at all the stages of plant growth followed by V_7 (Bhima Shubhra) and V_5 (Bhima Super). While minimum number of leaves was found with V_2 (Arka Bheem). At 30 and 60 DAT the difference between V_8, V_7, V_5 and V_3 were non significant. At 90 DAT V_8, V_7 and V_5 were at par. Combined effect of transplanting dates and varieties indicated non significant effect on number of leaves at all the stages of growth.

Table 2: Effect of transplanting dates, varieties and their interaction on number of leaves per plant of *kharif* onion

Treatment	Number of leaves		
	30 DAT	60 DAT	90 DAT
Transplanting dates (D)			
D_1	4.87	6.27	8.03
D_2	5.15	6.60	8.88
S.Em ±	0.09	0.11	0.29
CD at 5%	0.27	0.33	0.63
Varieties (V)			
V_1	4.53	5.88	7.40
V_2	4.48	5.57	7.10
V_3	5.07	6.47	8.87
V_4	4.70	6.27	7.93
V_5	5.23	6.70	9.13
V_6	4.97	6.43	8.33
V_7	5.53	6.90	9.23
V_8	5.57	7.23	9.63
S.Em ±	0.19	0.23	0.44
CD at 5%	0.54	0.66	1.29
Interaction (D x V)			
D_1V_1	4.40	5.60	7.07
D_1V_2	4.50	5.93	7.20
D_1V_3	4.93	6.33	8.47
D_1V_4	4.67	6.20	7.80
D_1V_5	5.00	6.40	8.73
D_1V_6	4.53	6.00	7.27
D_1V_7	5.33	6.27	8.07
D_1V_8	5.60	7.40	9.67
D_2V_1	4.67	6.17	7.73
D_2V_2	4.47	5.20	7.00
D_2V_3	5.20	6.60	9.27
D_2V_4	4.73	6.33	8.07
D_2V_5	5.47	7.00	9.53
D_2V_6	5.40	6.87	9.40
D_2V_7	5.73	7.53	10.40
D_2V_8	5.53	7.07	9.60
S.Em ±	0.27	0.32	0.62
CD at 5%	NS	NS	NS

Fresh weight of shoot

The data presented in Table 3 showed significant effect of transplanting dates, varieties and their combination on fresh weight of shoot at all the stages of growth. Transplanting dates had significant influence on fresh weight of shoot per plant at all the stages. Transplanting of onion seedlings at D_2 (25th August) recorded maximum fresh weight of shoot. Minimum fresh weight of shoot was observed with transplanting on D_1 (10th August). The difference between D_2 (25th August) and D_1 (10th August) was significant at all stages of plant growth. In general, there was increase in fresh weight of plant up to 90 days after transplanting. Variety V_8 (Agrifound Dark Red) recorded maximum fresh weight of shoot followed by V_7 (Bhima Shubhra) and V_5 (Bhima Super) at all the stages of growth. At 30 and 90 DAT the difference between V_8, V_7, V_5 and V_3 were non significant. But at 60 DAT variety V_8 was significantly superior over all other varieties. At harvesting stage V_8, V_7 and V_5 were at par. While minimum fresh weight of shoot was observed in case of variety V_2 (Arka Bheem) at all the stages under study. Combined effect of transplanting dates and varieties showed significant effect on fresh weight of shoot. Maximum values of fresh weight of shoot was recorded under D_2V_7 (Bhima Shubhra with 25th August transplanting) at all stage of growth which was followed by D_1V_8 (Agrifound Dark Red with 10th August transplanting) and D_2V_8 (Agrifound Dark Red with 25th August transplanting). However, minimum fresh weight of shoot was observed under the combination of D_2V_2 (Arka Bheem with 25th August transplanting).

Table 3: Effect of transplanting dates, varieties and their interaction on fresh weight of shoot per plant (g) of *kharif* onion

Treatment	Fresh weight of shoot per plant (g)			
	30 DAT	60 DAT	90 DAT	At harvest
Transplanting dates (D)				
D_1	2.37	13.38	44.99	32.68
D_2	2.63	15.83	50.47	35.42
S.Em ±	0.05	0.37	1.17	0.89
CD at 5%	0.16	1.06	3.40	2.58
Varieties (V)				
V_1	1.89	10.61	38.57	28.03
V_2	1.70	9.51	33.78	24.22
V_3	2.72	15.76	51.22	35.72
V_4	2.50	12.31	45.89	32.50
V_5	2.82	17.14	53.72	36.83
V_6	2.41	14.41	46.24	32.50
V_7	2.94	17.30	55.44	41.22
V_8	3.02	19.82	57.00	41.39
S.Em ±	0.11	0.73	2.36	1.77
CD at 5%	0.33	2.12	6.81	5.12
Interaction (D x V)				
D_1V_1	1.78	10.29	34.02	27.33
D_1V_2	1.87	10.37	35.67	27.56
D_1V_3	2.66	15.49	48.44	34.67
D_1V_4	2.36	11.39	45.67	31.00
D_1V_5	2.70	15.58	52.89	36.00
D_1V_6	2.01	10.79	38.26	28.00
D_1V_7	2.59	12.71	46.11	33.22
D_1V_8	3.02	20.43	58.89	43.67
D_2V_1	2.01	10.93	43.11	28.72
D_2V_2	1.53	8.66	31.89	20.89
D_2V_3	2.79	16.03	54.00	36.78
D_2V_4	2.64	13.23	46.11	34.00
D_2V_5	2.94	18.70	54.56	37.67
D_2V_6	2.80	18.02	54.22	37.00
D_2V_7	3.29	21.89	64.78	49.22
D_2V_8	3.01	19.21	55.11	39.11
S.Em ±	0.16	1.04	3.34	2.53
CD at 5%	0.47	2.99	9.63	7.30

Dry weight of shoot

The data presented in Table 4 showed significant effect of transplanting dates, varieties and their combination on dry weight of shoots at all the stages of growth. It can be observed from Table 9 that the dry weight of plant was significantly affected with transplanting dates. Transplanting of onion seedlings at D_2 (25th August) recorded maximum dry weight of shoot. Minimum dry weight of shoot was observed with transplanting on D_1 (10th August). The difference between D_2 (25th August) and D_1 (10th August) was significant at all the stages of plant growth. Among the varieties maximum dry weight of shoot per plant was observed under V_8 (Agrifound Dark Red) followed by V_7 (Bhima Shubhra) and V_5 (Bhima Super) at all the stages of plant growth. The minimum dry weight of shoot was observed in case of variety V_2 (Arka Bheem). At 30 DAT V_8, V_7 and V_5 were at par. At 60, 90 DAT and at harvesting stage the difference between V_8, V_7, V_5 and V_3 were non significant. Combined effect of transplanting dates and varieties showed significant effect on dry weight of shoot. Maximum dry weight of shoot was noted with D_2V_7

(Bhima Shubhra with 25th August transplanting) at all stage of growth which was followed by D_1V_8 (Agrifound Dark Red with 10th August transplanting) and D_2V_8 (Agrifound Dark Red with 25th August transplanting). However minimum dry weight of shoot was observed under D_2V_2 (Arka Bheem with 25th August transplanting).

Table 4: Effect of transplanting dates, varieties and their interaction on dry weight of shoot per plant (g) of *kharif* onion

Treatment	Dry weight of shoot per plant (g)			
	30 DAT	60 DAT	90 DAT	At harvest
Transplanting dates (D)				
D_1	0.27	1.33	3.78	3.28
D_2	0.31	1.57	4.20	3.55
S.Em ±	0.01	0.04	0.09	0.06
CD at 5%	0.02	0.10	0.27	0.18
Varieties (V)				
V_1	0.22	1.07	3.16	3.07
V_2	0.19	1.03	2.70	2.86
V_3	0.31	1.62	4.49	3.53
V_4	0.27	1.36	3.92	3.29
V_5	0.34	1.64	4.47	3.61
V_6	0.29	1.36	3.96	3.36
V_7	0.34	1.66	4.51	3.79
V_8	0.37	1.83	4.73	3.80
S.Em ±	0.02	0.07	0.19	0.12
CD at 5%	0.05	0.21	0.54	0.36
Interaction (D x V)				
D_1V_1	0.20	1.03	2.87	2.91
D_1V_2	0.22	1.04	3.00	2.93
D_1V_3	0.29	1.59	4.38	3.36
D_1V_4	0.25	1.17	3.67	3.27
D_1V_5	0.33	1.58	4.28	3.51
D_1V_6	0.24	1.08	3.28	3.04
D_1V_7	0.26	1.32	4.06	3.31
D_1V_8	0.39	1.81	4.73	3.88
D_2V_1	0.24	1.12	3.46	3.22
D_2V_2	0.17	1.02	2.40	2.79
D_2V_3	0.33	1.64	4.60	3.70
D_2V_4	0.29	1.56	4.17	3.32
D_2V_5	0.35	1.70	4.66	3.71
D_2V_6	0.34	1.65	4.64	3.67
D_2V_7	0.42	2.00	4.97	4.27
D_2V_8	0.35	1.80	4.72	3.73
S.Em ±	0.02	0.10	0.26	0.17
CD at 5%	0.07	0.29	0.76	0.50

Chlorophyll content in leaves (SPAD value)

The findings (Table 5) revealed significant influence of transplanting dates and varieties at all the stages of study. Transplanting of onion seedlings at D_2 (25th August) recorded maximum SPAD value in leaves at all the stages i.e. 30, 60 and 90 DAT. The difference between D_2 (25th August) and D_1 (10th August) was significant at all stages of plant growth under study. Among the varieties, maximum SPAD value was found in case of V_7 (Bhima Shubhra) which was followed by V_8 (Agrifound Dark Red) and V_3 (Bhima Red). Minimum SPAD value was observed under variety V_2 (Arka Bheem) at all the stages. At 30 DAT the difference between V_7, V_8, V_3, V_5, V_4 and V_6 were non significant. At 45 and 60 DAT V_7 and V_8 were at par. Combined effect of transplanting dates and varieties showed non significant influence on SPAD value in leaves at all stages.

Table 5: Effect of transplanting dates, varieties and their interaction on Chlorophyll content in leaves (SPAD value) of *kharif* onion

Treatment	Chlorophyll content in leaves (SPAD value)		
	30 DAT	45 DAT	60 DAT
Transplanting dates (D)			
D_1	55.15	55.92	57.06
D_2	58.98	61.10	61.34
S.Em ±	1.28	1.50	1.48
CD at 5%	3.70	4.33	4.28
Varieties (V)			
V_1	52.82	54.32	54.10
V_2	50.13	52.70	53.38
V_3	59.03	58.28	59.18
V_4	56.82	56.93	57.72
V_5	56.87	56.67	58.13
V_6	56.28	56.47	58.18
V_7	62.83	68.50	68.82
V_8	61.73	64.22	64.08
S.Em ±	2.56	3.00	2.96
CD at 5%	7.40	8.67	8.56
Interaction (D x V)			
D_1V_1	47.73	49.90	50.13
D_1V_2	49.13	50.00	52.00
D_1V_3	57.63	55.00	56.90
D_1V_4	57.53	55.33	57.63
D_1V_5	54.07	53.67	55.17
D_1V_6	52.90	52.93	55.07
D_1V_7	60.13	64.03	65.27
D_1V_8	62.10	66.47	64.30
D_2V_1	57.90	58.73	58.07
D_2V_2	51.13	55.40	54.77
D_2V_3	60.43	61.57	61.47
D_2V_4	56.10	58.53	57.80
D_2V_5	59.67	59.67	61.10
D_2V_6	59.67	60.00	61.30
D_2V_7	65.53	72.97	72.37
D_2V_8	61.37	61.97	63.87
S.Em ±	3.63	4.25	4.19
CD at 5%	NS	NS	NS

Transplanting of onion seedlings at D_2 (25th August) recorded maximum plant height, number of leaves, fresh weight of shoot and dry weight of shoot at all the stages of plant growth. Minimum plant height, number of leaves, fresh weight of shoot and dry weight of shoot was observed in case of D_1 (10th August) with significant difference. This might be due to the fact that late transplanting provided favourable environmental conditions especially temperature which stimulated vegetative growth for longer period. Similar findings have been also reported by Gautam *et al.* (2006), Nayee *et al.* (2009) [9] and Mohanta and Mandal (2014) [7] in onion.

Onion varieties were significantly differed for the growth parameters. Maximum plant height, number of leaves, fresh weight of shoot and dry weight of shoot were recorded with variety V_8 (Agrifound Dark Red) at all the stages of growth, followed by V_7 (Bhima Shubhra) and V_5 (Bhima Super). Minimum plant height was observed in case of V_2 (Arka Bheem). The difference in behaviour of the varieties could be explained by the variation in their genetic make-up and differential behaviour under different climatic condition. Higher plant height and number of leaves might have resulted in more photosynthesis and accumulation of food material,

resulting in higher fresh and dry weight of plant. Similar results have also been reported by Dwivedi *et al*. (2012), Mohanta and Mandal (2014) [7], Bindu and Podikunju (2016) [1] in onion.

Combined effect of transplanting dates and varieties showed significant effect on fresh weight of shoot and dry weight of shoot but not in plant height and number of leaves. Maximum values of fresh and dry weight were recorded under D_2V_7 (Bhima Shubhra with 25th August transplanting) at all stage of growth which was followed by D_1V_8 (Agrifound Dark Red with 10th August transplanting) and D_2V_8 (Agrifound Dark Red with 25th August transplanting). However, minimum fresh and dry weights of shoot were observed under the combination of D_2V_2 (Arka Bheem with 25th August transplanting). The difference among the varieties could be attributed by the variation in their genetic make-up and differential effect behaviour under different climatic conditions due to transplanting dates.

Conclusion

On the basis of present experiment, it may be concluded that, among the varieties V_8 (Agrifound Dark Red) was superior looking to higher growth attributes, followed by variety V_7 (Bhima Shubhra), V_5 (Bhima Super) and V_3 (Bhima Red) which are at par to each other. Among the different transplanting dates D_2 (25th August) proved best for growth. The combined effect of transplanting dates and varieties showed that V_7 (Bhima Shubhra) transplanted on 25th August recorded highest growth under Mandsaur (M.P.) conditions.

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