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Research Article

Study of the Growth of Different Onion Varieties for Crop Improvement Purposes

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ABSTRACT

Study Research Farm of Department of Horticulture, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Indore, (M.P.). The highest plant height was recorded in genotypes Agrifound white and Mahasuper red and which were at par with each other. Therefore, it was observed lowest in genotype Bhima shakti at all the growth stages. Genotypes Agrifound white, Mahasuper red, and N-2-4-1 were recorded in significantly maximum leaves per plant at 30, 60, 90 and 120 DAT and which were at par with each other. However, it was observed lowest in genotype Bhima shakti for the same. At 30, 60, 90 and 120 DAT, the significantly maximum leaf length was recorded under the genotypes Agrifound white followed by Mahasuper red, N-2-4-1 and Bhima sweta and which were at par with each other. While, minimum leaf length was recorded in genotype Bhima shakti. In case of 30, 60, 90 and 120 DAT, the dry weight per plant was significantly increased by the different genotypes. The Agrifound white was found significantly superior as compared to other genotypes. Highest dry weight per plant was recorded in genotype Agrifound white, followed by Mahasuper red and N-2-4-1. However, lowest dry weight per plant was noted under the genotype Bhima shakti at 30, 60, 90 and 120 DAT. Significantly lowest 0.42 bolting per cent were observed in genotype Agrifound white followed by Mahasuper red (0.96%) and N-2-4-1 (1.04%) as compared to other genotypes. Therefore, it was noted maximum 5.88 bolting per cent under the genotype Bhima shakti.

Key words: *Onion, Tomato, Cabbage, Watermelon*

INTRODUCTION

Onion (*Allium cepa* L.) belongs to the family Liliaceae, an important group of crops grown worldwide[4]. It is divided into three groups: *Allium cepa, Allium cepa* var. aggregatum, Allium proliferum, which are all diploids (2n = 2x = 16)[3]. The crop is a biennial herb of Central Asian origin (Afghanistan, Iran and Pakistan) and it is cultivated all around the world.

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Onion occupies 4th position in the world level after tomato, cabbage and watermelon with a global annual production of 25 million tonnes[3]. Onion is a momentous source of vitamin C and potassium, contains about 60 calories in a medium-sized bulb and has very low sodium content. The bulbs provide 2.0 g protein, 72 mg calcium and 54 mg phosphorus. It also contains vitamins *viz.*, thiamine, riboflavin and niacin and is used for its medicinal value especially in the case of heart problems[8].

The onion is recognized as one of the most important vegetable crops that cultivated throughout the world since its introduction to the worlds. It has grown mainly as a food source and used as cousins and value addition for different dishes. In Ethiopia, the consumption of the crop is very important in the food seasoning and in daily stews as well as in different vegetable food preparation uses. Also, the chemical flavonoids, anthocyanins, fructo- oligosaccharides and organ sulphur compounds found in the onion is considered as medicinal and health benefits to fight different diseases including cancer, heart and diabetic diseases[5]. Plant growth regulators have a potential role in modern agriculture[2] and have been known as key element for vegetative growth and bulbing[10,9]. Besides stimulating the growth processes, they also affect seed development, organ elongation, senescence and control of flowering time[8.9.5]. GA3 play a vital role to vigorous growth, that promoted the total plant length of onion by 35% of the control and also increased the number of leaves, fresh and dry weight significantly[9]. Thus GA3 have the promoter effect on the growth and development of bulb crops, as well as the total yield[6,7,1].

MATERIAL AND METHODS

The present experiment was laid out in the field of the Research Farm, Department of Horticulture, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Indore during Kharif season, 2013-14. The land topography of the experimental site was almost uniform with an adequate surface drainage. The internal drainage of the experimental site is medium.

Indore is situated in Malwa plateau region in the Western part of the state of Madhya Pradesh at an altitude of 555.5 meters above mean sea level (MSL). It is located at latitude 22.43^{o} N and longitude of 75.66^{o} E. It has subtropical climate having a temperature range of 21^{o} C to 45^{o} C and 6^{o} C to 31^{o} C in summer and winter seasons, respectively. The rainfall in the region has been mostly inadequate and erratic in most of the recent past seasons. Late commencement, early withdrawal of monsoon and occurrence of two to three dry spells during the rainy season are the common features. The mean annual average rainfall is 964 mm. The meteorological data during crop growth period from the first week of 25th June, 2013 to last week of January, 2014. The data indicate that the total rainfall received during crop growth period was 1389.6 mm. There were no rains during SMW 42 to 47 and 49 – 04. The minimum and maximum temperature during crop growth period varied 6.5^{0}C to 23.0^{0}C and from 20.4^{0}C to 34.0^{0}C, with season's average values of 16.00^{0}C and 27.17^{0} C respectively. The relative humidity and wind speed ranged between 70.0 to 86.9 % and 1.4 to 10.0 km hrs^{-1} with season's average of 80.60% and 4.17 km hrs^{-1} respectively.

The experiment was laid out in Completely Randomized Block Design (CRBD) with three replications. Each replication consists of 12 genotypes. All the genotypes were randomized separately in each replication.

1.1 Leaf area index (LAI)

The assimilatory surface area (A) was recorded in at random five plants from each treatment and replications by using electronic leaf area meter. LAI is the leaf area (A) or the assimilatory surface area over a certain ground area (P) and is calculated by the formula given by

$$LAI = \frac{A}{P}$$

Where,

A= Leaf area
P= Ground area

1.2 NAR (Net assimilation rate)

It is the measurement of the rate of photosynthesis per unit time on the basis of dry matter and is expressed as mg/cm2 day-1. It was worked out as per the following formula.

$$NAR = \frac{(W2 - W1)}{(A2 - A1)} \times \frac{(\log A2 - \log A1)}{(t2 - t1)}$$

Where,

A1 and W1 are the leaf area and dry weight of the plant sample respectively at time t1 and A2 and W2 are the leaf area and dry weight of the plant sample respectively at time t2.

2.3 Crop growth rate

Crop growth rate also called the rate of dry matter production. The crop growth rate is expressed as g/m2 day-1.

$$CGR = \frac{W2 - W1}{P\,(T2 - T1)}$$

Where,

P = Ground area on which W1 and W2 were estimated.
W1= Dry weight of plant at 1st observation.
W2= Dry weight of plant at 2nd observation.
T1 & T2 = interval between observation.

RESULTS AND DISCUSSION

3.1. Leaf area per plant (cm^2)

The leaf area per plant was recorded and has been presented in table 1

Table 1: Leaf area per plant (cm2) as affected by different genotypes of onion at 30, 60, 90 and 120 DAT

S. No.	Genotypes	Leaf area per plant (cm^2) at			
		30 DAT	60 DAT	90 DAT	120DAT
1	Bhima shakti	58.99	149.98	384.47	445.62
2	Bhima sweta	101.68	304.61	685.36	951.57
3	Agrifound white	164.06	379.40	794.57	1104.47
4	Bhima kiran	98.77	286.94	652.32	944.78
5	L 355	79.93	256.94	568.97	654.28
6	Bhima super	93.79	273.01	627.45	863.45
7	N-2-4-1	107.34	327.43	720.70	972.93
8	Bhima shubhra	83.66	272.99	575.50	859.08
9	Bhima red	97.81	286.46	652.32	870.86
10	Bhima raj	65.74	195.90	461.86	606.10
11	Akshda mahasuper	77.02	245.29	492.80	643.00
12	Mahasuper red	140.65	361.41	730.18	995.78
SEm±		2.50	18.49	26.40	82.70
C.D. at 5% level		7.34	54.26	77.46	242.58

It is obvious from the Table 1 that the leaf area per plant was significantly influenced by the different genotypes of onion. Agrifound white was observed highest leaf area per plant (164.06, 379.40 and 794.57 cm2) which was followed by Mahasuper red (140.65, 361.41 and 730.18 cm2) and N-2-4-1 (107.34, 327.43 and 720.70 cm2) at 30, 60 and 90 DAT respectively and which were at par with each other at 60 and 90 DAT. The lowest leaf area per plant (58.99, 149.98 and 384.47 cm2) was recorded in Bhima shakti at 30, 60 and 90 DAT respectively.

In case of 120 days after transplanting, the significantly maximum 1104.47, 995.78, 972.93, 951.57, 944.78, 870.86 and 863.45 cm2 leaf area per plant were recorded in genotypes Agrifound white, Mahasuper red, N-2-4-1, Bhima sweta, Bhima kiran, Bhima red and Bhima super, respectively and which were at par with each other. Therefore, it was observed minimum in genotype Bhima shakti (445.62 cm2).

3.2. Leaf area index

The results have been presented in Table 2. The leaf area index was significantly influence due to various onion genotypes. The Agrifound white was observed maximum leaf area index (1.46, 3.37, 7.06 and 9.82) which was followed by Mahasuper red (1.25, 3.21, 6.49 and 8.85) and N-2-4-1 (0.95, 2.91, 6.41 and 8.65) at 30, 60, 90 and 120 DAT, respectively and which were at par with each other at 60, 90 and 120 DAT. Whereas, the leaf area index was observed lowest (0.52, 1.33, 3.42 and 3.96)in Bhima shakti at 30, 60, 90 and 120 DAT,respectively.

Table 2: Leaf area index as affected by different genotypes of onion at 30, 60, 90 and 120 DAT

S. No.	Genotypes	Leaf Area Index at			
		30 DAT	60 DAT	90 DAT	120DAT
1	Bhima shakti	0.52	1.33	3.42	3.96
2	Bhima sweta	0.90	2.71	6.09	8.46
3	Agrifound white	1.46	3.37	7.06	9.82
4	Bhima kiran	0.88	2.55	5.80	8.40
5	L 355	0.71	2.28	5.06	5.82
6	Bhima super	0.83	2.43	5.58	7.68
7	N-2-4-1	0.95	2.91	6.41	8.65
8	Bhima shubhra	0.74	2.43	5.12	7.64
9	Bhima red	0.87	2.55	5.80	7.74
10	Bhima raj	0.58	1.74	4.11	5.39
11	Akshda mahasuper	0.68	2.18	4.38	5.72
12	Mahasuper red	1.25	3.21	6.49	8.85
SEm±		0.02	0.16	0.23	0.73
C.D. at 5% level		0.06	0.48	0.68	2.15

3.3. Net assimilation rate (mg/cm2/day)

The data on net assimilation rate (mg/cm2/day) of different genotypes is given in Table 3 at 30-60,60-90,90-120 DAT and 120-140 DAT. The data presented in Table 3 clearly showed that there was non-significant difference amongst the genotypes at 90-120 and 120-140 DAT of observations. The NAR in general decreased at 60-90 DAT and 120-140 DAT in all the genotypes. The significantly maximum 1.241 and 0.967 mg/cm2/day net assimilation rate was observed under the genotype Agrifound white followed by Mahasuper red (1.029 and 0.661 mg/cm2/day), N-2-4-1 (0.713 and 0.621 mg/cm2/day) and Bhima sweta (0.669 and 0.613 mg/cm2/day) at 30-60 and 60-90 DAT respectively. The lowest NAR 0.361 and 0.243 mg/cm2/day was recorded in Bhima shakti at 30-60 and 60-90 DAT, respectively.

The highest 3.024 and 2.091 mg/cm2/day NAR was found in Agrifound white and the lowest (0.259 and 0.071 mg/cm2/day) was observed in genotype Bhima shakti at 90-120 and 120-140 DAT , respectively.

Table 3: Net assimilation rate (mg/cm2/day) at different stages of plant growth of onion

S. No.	Genotypes	NAR (mg/cm2/day) at			
		30-60 DAT	60-90 DAT	90-120 DAT	120-140 DAT
1	Bhima shakti	0.361	0.243	0.259	0.071
2	Bhima sweta	0.669	0.613	0.793	1.229
3	Agrifound white	1.241	0.967	3.024	2.091
4	Bhima kiran	0.667	0.510	0.717	1.053
5	L 355	0.545	0.296	0.507	0.283
6	Bhima super	0.644	0.367	0.622	0.888
7	N-2-4-1	0.713	0.621	0.823	1.338
8	Bhima shubhra	0.571	0.351	0.577	0.785
9	Bhima red	0.654	0.391	0.665	0.974
10	Bhima raj	0.473	0.271	0.380	0.141
11	Akshda mahasuper	0.483	0.274	0.491	0.166
12	Mahasuper red	1.029	0.661	1.717	1.376
SEm±		0.063	0.085	0.525	0.468
C.D. at 5% level		0.184	0.251	N.S.	N.S.

3.4. Crop growth rate (g/m2/day)

The mean crop growth rate of different genotypes are given in Table 4 at 30-60 DAT, 60-90 DAT, 90-120 DAT and 120-140 DAT.

Table 4: Crop growth rate (g/m2/day) at different stages of plant growth of onion

S. No.	Genotypes	CGR (g/m2/day) at			
		30-60 DAT	60-90 DAT	90-120 DAT	120-140 DAT
1	Bhima shakti	0.0091	0.0203	0.0151	0.0040
2	Bhima sweta	0.0276	0.0268	0.0319	0.0509
3	Agrifound white	0.0282	0.0299	0.0347	0.0800
4	Bhima kiran	0.0274	0.0257	0.0315	0.0505
5	L 355	0.0246	0.0223	0.0285	0.0116
6	Bhima super	0.0263	0.0237	0.0304	0.0487
7	N-2-4-1	0.0276	0.0272	0.0325	0.0550
8	Bhima shubhra	0.0262	0.0232	0.0301	0.0391
9	Bhima red	0.0263	0.0254	0.0308	0.0495
10	Bhima raj	0.0159	0.0214	0.0200	0.0093
11	Akshda mahasuper	0.0231	0.0219	0.0283	0.0111
12	Mahasuper red	0.0277	0.0283	0.0338	0.0699
SEm±		0.0004	0.0004	0.0010	0.0019
C.D. at 5% level		0.0012	0.0013	0.0029	0.0057

It is obvious from the Table 4 clearly indicated that there was significant difference amongst the genotypes at all the stages of observations. In general CGR increased with increase in crop growth stages. The significantly maximum 0.0282, 0.0299, 0.0347 and 0.0800 g/m2/day crop growth rate was observed under the genotype Agrifound white and followed by Mahasuper red (0.0277, 0.0283, 0.0338 and 0.0699 g/m2/day), N-2-4-1 (0.0276, 0.0272, 0.0325 and 0.0550 g/m2/day) and Bhima sweta (0.0276, 0.0268, 0.0319 and 0.0509 g/m2/day) at 30-60 DAT, 60-90 DAT, 90-120 DAT and 120-140 DAT, respectively and which were at par with each other at 90-120 DAT only. Therefore, it was observed lowest 0.0091, 0.0203, 0.0151 and 0.0040 g/m2/day in genotype Bhima shakti at 30-60 DAT, 60-90 DAT, 90-120 DAT and 120 -140 DAT, respectively.

Effect of different genotypes of onion on growth analytical parameter

Among growth analytical parameters, the leaf area per plant, leaf area index, net assimilation rate and crop growth rate were studies in onion.

It is obvious from the data that the leaf area per plant was significantly influenced by the different genotypes of onion. Agrifound white was observed highest leaf area per plant which was followed by Mahasuper red and N-2-4-1 at 30, 60, 90 and 120DAT and which were at par with each other at 60, 90 and 120 DAT. The lowest leaf area per plant was recorded in Bhima shakti for the same. Leaf area was significantly increased by nitrogen, possibly because nitrogen helps in greater assimilation of food material by the plant which resulted in greater meristematic activities of cells and consequently the number of leaves, length and width of leaf of plant.

The leaf area index was significantly influence due to various onion genotypes. The Agrifound white was observed maximum leaf area index which was followed by Mahasuper red and N-2-4-1 at 30, 60, 90, 120 DAT and at harvest and which were at par with each other at 60, 90 and 120 DAT. Whereas, the leaf area index was observed lowest in Bhima shakti at 30, 60, 90 and 120 DAT. Leaf area index was also significantly increased by nitrogen, possibly because nitrogen helps in greater assimilation of food material by the plant which resulted in greater meristematic activities of cells and consequently the number of leaves, length and width of leaf of plant. Similar results have been reported by Bosch Serra and Domingo Olive, Neeraja *et al*., Ushakumari *et al*., Channagoudar and Janawade and Rastegar and Khodadadi.

The data clearly showed that there was non-significant difference amongst the genotypes at 120 DAT of observations. The NAR in general decreased at 90 DAT in all the genotypes. The significantly maximum net assimilation rate was observed under the genotype Agrifound white followed by Mahasuper red, N-2-4-1 and Bhima sweta at 60 and 90 DAT. The lowest NAR was recorded in Bhima shakti at 60 and 90 DAT.

The highest NAR was found in Agrifound white and the lowest was observed in genotype Bhima shakti at 120 DAT. NAR declined as the crop advanced at 60-30 DAT and LAI increase at 60 DAT in comparison to 30 DAT. This revealed that as the LAI increased the shading effect of the leaves may have caused reduction in photosynthesis and NAR. It may also be due to the reduced photosynthesis of the older leaves.

It is revealed from the data clearly indicated that there was significant difference amongst the genotypes at all the stages of observations. In general CGR increased with increase in crop growth stages. The significantly maximum crop growth rate was observed under the genotype Agrifound white and followed by Mahasuper red, N-2-4-1 and Bhima sweta at 30-60 DAT, 60-90 DAT, 90-120 DAT and 120-140 DAT and which were at par with each other at 90-120 DAT only. Therefore, it was observed lowest in genotype Bhima shakti at 30-60 DAT, 60-90 DAT, 90-120 DAT and 120-140 DAT.

CONCLUSION

On the basis of present investigation, it is concluded that the onion genotype Agrifound

white responded well in terms of growth, growth analytical, yield and quality parameters and suitable for commercial production in Malwa condition in kharif season. Genotypes Agrifound white was observed best for growth (i.e. significantly maximum plant height, number of leaves per plant, leaf length, dry weight per plant, bulb and green top ratio and minimum neck thickness, bolting per cent, duration of the crop), yield parameters (fresh weight of bulb, polar diameter of bulb, equatorial diameter of bulb, bulb yield per hectare and long crop duration and lowest percentage of doubles bulb,) was recorded maximum in this genotypes. It was also observed best quality. It is revealed form the date obtained that a significantly maximum bulb yield of 338.67q per ha was obtained in onion genotype Agrifound white with net return of Rs 2,87,656 per ha and cost benefit ratio 1:6.64 as compared to other genotypes.

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