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Performance of different genotypes of onion (*Allium cepa* L.) in *Rabi* season under semi-arid eastern plain zone of Rajasthan

Pravin Singh, SK Khandelwal and Deepak Gupta

Abstract
The present investigation was carried out to estimate genetic variability among thirty genotypes of onion for different characters comprised of bulb yield and its contributing characters. These genotypes were planted in Randomized Block Design with three replications during *Rabi*-2016-17, SKN College of Agriculture, Jobner. On the basis of mean performance, the genotype ROG-29 was the highest yielder. These genotypes may further be utilized in breeding programme aimed at improving bulb yield in onion. Analysis of variance indicated presence of considerable variability for all the characters. High GCV and PCV were observed for neck thickness, dry matter content and number of fleshy scale leaves. High estimates of heritability along with high genetic advance as per cent of mean was observed for dry matter content, pungency, TSS, bulb volume, equatorial diameter, average bulb weight and bulb yield ha^{1}. Therefore, these characters can laid in selection programme.

Keywords: Genetic variability. genotypes and onion

Introduction
Onion (*Allium cepa* L.) is one of the most important worldwide vegetable crops grown extensively throughout the country under diverse agro-climatic conditions, which results in fluctuation in its production; one of the constraints in increasing production is the lack of stability of high yielding and widely adapted varieties. In India, onion is cultivated throughout the country mainly in states of Maharashtra, Karnataka, Madhya Pradesh, Gujarat, Rajasthan and Bihar occupying an area of 1914 thousand hectares with production of 31.12 million tonnes. In Rajasthan, it is grown extensively in Alwar, Ajmer, Jodhpur, Sikar, Nagaur, Jhunjhunu, Jaipur and Bikaner districts occupying an area of about 91.90 thousand ha and total production of 1.447 million tonnes.

Onion is popularly known as "Queen of kitchen" because of its characterstic flavor and its anticarcinogenic, activity, antioxidant, antiasthmatic, immunomodulating and antimicrobial property. It is an important condiment used widely since ancient time as salad and for cooked in many ways in curries fried, boild, baked and used in making soups, pickles etc.

Onion (*Allium cepa* L.) is one of the important major vegetable crops in India. Plant breeders are primarily concerned with the improvement of quantitative and qualitative characters of any crop. This can be achieved by quantifying the genetic variation available for various characters of economic importance and inter-relationship among them. To improve the yield through selection of better varieties, knowledge on the nature of association of bulb yield with yield contributing characters is very essential. A cultivar crop performs differently under different agro-climatic conditions and various cultivars of the same species grown even in the same environment give different yields as the performance of a cultivar mainly depends on the interaction of genetic makeup and environment.

Hence, the present research was conducted to evaluate performance of thirty genotypes of onion with the objective of identifying the genotypes with highest yield and quality under Semi-arid eastern plain zone of Rajasthan.

Materials and Methods
The experiment was conducted at Rajasthan Agricultural Research Institute, Durgapura, Jaipur (Rajasthan). Geographically this place is situated between 75º47' East longitudes and at 26º51' North latitude and at an altitude of 390 m above mean sea level in Jaipur district of Rajasthan.

This region falls under Agro-climatic zone IIIa (Semi-arid eastern plain zone) of Rajasthan.

The experimental material for present study comprised of 30 onion reference genotypes *viz*., RO-01, RO-59, RO-252, RO-282, ROG-03, ROG-06, ROG-07, ROG-08, ROG-14, ROG-16, ROG-17, ROG-20qq, ROG-21, ROG-22, ROG-23, ROG-26, ROG-29, ROG-32, ROG-34, ROG-39, ROG-44, ROG-45, ROG-46, ROG-47, RO-645, RO-654, Rasidpur, Agrifound Dark Red and Bhima Shakti. These 30 genotypes were evaluated in Randomized Block Design with three replications at Instructional Farm, Rajasthan Agricultural Research Institute, Durgapura, (SKNAU University, Jobner}, Jaipur (Rajasthan) during *Rabi* seasons 2017-18. Randomization of lines was done with the help of random number table as advocated by Fisher (1954). The plot size was 4.00 m x 0.90 m. accommodating six rows of each entry. All the recommended agronomic practices and plant protection measures were followed timely to raise a good crop. The data were recorded on ten randomly selected competitive plants for individual genotype in each replication for bulbs yield and its contributing traits. Sixteen observations were recorded during research study they are like plant height (cm) at 90 DAP, number of leaves at 90 DAP, bolting (%), days to harvesting, neck thickness (cm), polar diameter of bulb (cm), equatorial diameter (cm), average bulb weight (g), marketable and total bulb yield ha^{-1} (q.), total Soluble Solids (%), dry weight of bulb (%), chlorophyll content (mg/g) in leaves and pungency in bulb (µmol/g) suggested by the Hort and Fisher (1971) [1] method. The statistical parameters like mean, range were calculated as per the standard methods of analysis (Panse and Sukhatme, 1957) [20].

Results and Discussion

Mean performance serves as an important criterion in eliminating the undesirable types in a selection programme. The results of the present investigation revealed that there exists significant difference for growth, yield and quality characters among the different cultivars of onion. The analysis of variance revealed that genotypes were significant for all the characters indicating genotype differences for all characters studied.

The highest plant height (59.33 cm) was observed in ROG 16 and it was found significant differ with the rest of genotype whereas the lowest plant height (27.0 cm) was recorded by ROG 47. Similar variability in plant height between genotypes confirming by Ibrahim (2010) [12], Azoom *et al.* (2014) [8] and Thingalmaniyan *et al.* (2017) [18].

Number of leaves influences the yield to a significant extent decide the spread of the plant. The maximum number of leaves per plant was found under Genotype ROG 35 (11.75) which was at par with ROG 14, ROG 20, ROG 34, ROG 44, ROG 45 and Bhima Shakti whereas minimum leaves (5.60) were recorded on ROG 52. Boukary *et al.* (2012) [9], Dwivedi *et al.* (2012) [10], Menon *et al.* (2016) [6] and Bandari *et al.* (2021) [19] observed the difference in production of leaves between varieties of onion and attributed this difference mainly to the cultivar. The genotypes RO 252, RO 282, ROG-645 and ROG 654 (0.00) had the lowest mean bolting, whereas, the genotype ROG 06 had the highest mean bolting (15.22%).

The days to maturity was recorded at 75 per cent of neck fall observed. There was significant variation seen among the genotypes. The general mean for days to maturity was 125.69 days and it ranged from 122.59 to 132.80 days. ROG 7 (122.59 days) requires minimum number of days to maturity followed by RO 59, RO 252 and ROG 282, while Bhiima Shakti (132.80days) required maximum number of day's maturity. Similar result was also reported by Bandari *et al.* (2021) [19].

Neck thickness varied from to 0.20 – 1.33 cm with an overall mean 0.41 cm. The maximum neck thickness was recorded in genotype Agrifound Dark Red (1.33 cm) while, the minimum neck thickness was recorded in genotype RO 645 (0.20 Cm). Dewangan *et al.*, (2012) [2] and Thingalmaniyan *et al.* (2017) [18] also find the same results.

Polar diameter (thickness) in onion is an important character, because it indicates bulb storage ability. The onion with thin polar diameter, store better than thick diameter of bulbs. There was significance difference on polar diameter of bulb due to genotypic effect. Polar diameter varied from 2.61 to 5.59 cm with an overall mean 4.47 cm. The maximum polar diameter was recorded in genotype ROG 07 which was at par with RO 1, ROG 16, ROG 29, ROG 45 and Agrifound Dark Red while, the minimum polar diameter was recorded in genotype Rasidpur (2.61 cm). These results are in agreement with the results of the study conducted by Gautam *et al.* (2006) [11], Azoom *et al.* (2014) [8] and Khusboo *et al.* (2018) [4].

The lowest average equatorial diameter of 3.08 cm was recorded in ROG 23 and highest equatorial diameter of 6.70 mm was found on RO 645 with an overall mean 4.94 cm. The maximum equatorial diameter was recorded in genotype ROG 23 (6.70 cm) followed by ROG 47 (6.55 cm) and ROG 45 (6.19 cm) and these three genotypes were found at par with each other. Stated that increased bulb diameter gave higher yield in onion. Singh (1990) [19], Khusboo *et al.* (2018) [4] and Bandari *et al.* (2021) [19] observed also similar results.

Yield is a complex trait influenced by many factors. In onion, the important yield contributing characters are average weight of bulb and bulb diameter. In the present experiments, significant variation in average weight of bulb was noticed. The importance of average weight of bulb as an important yield component has been reported by Bhandari *et al.* (2021) [19]. Average weight of bulb is the most important component that contributes directly to the bulb yield in onion. Among fifty genotypes, the range and general mean for average bulb weight was recorded 31.27 – 80.47 g and 55.65 g, respectively. Highest average bulb weight found in the genotype RO 645 (80.47 g) followed by ROG 20 (77.71 g) and both these genotypes were found at par with each other while, it was found lowest in RO 252 (31.27 g). Results of this study are in accordance with the findings of Boukary *et al.* (2012) [9], Moulin *et al.* (2012) [14] and Kasera *et al.* (2019) [3]. The highest average bulb of weight in this genotype may be due to its genetic character and adaptability to agroclimatic conditions by the place of the experiment.

For marketable yield, there was significant variation reported among genotypes. The average marketable yield was 305.88 q ha^{-1}. ROG 29 had the highest marketable yield (390.25 q ha^{-1}) followed by RO 645 (384.04 q ha^{-1}), ROG 45 (383.77 q ha^{-1}), ROG 20 (378.47 q ha^{-1}), ROG 16 (363.15 q ha^{-1}), ROG 46 (359.41 q ha^{-1}) and ROG 44 (353.35 q ha^{-1}) and these genotypes were found at par with each other. The genotype ROG 252 (170 q ha^{-1}) had the lowest marketable yield. The recorded variations of varieties in marketable yield could be due to their differences in genetic make-up (Pavlovic *et al.*

2003) [15] and agro ecological adaptations..

The quality parameters, *viz*., TSS, ascorbic acid and pyruvic acid contents mainly decide the quality and nutritive value of onion bulbs. Total soluble solids, an important quality criterion for onions, contribute towards flavours (Sharma *et al*., 1996) [16] and processing quality. The soluble solid content would ultimately decide the dry matter that in turn would reflect on the recovery of processed products. In the present investigations, maximum Total Soluble Solids was observed in genotype RO 1 (14.92ºB) followed by ROG 16 (14.65ºB) and minimum were observed in ROG 20 (8.22ºB). The higher TSS value in these genotypes may be due to its inherent characteristics. Similar results were observed by Pavlovic *et al*. (2003) [15], Thingalmaniyan *et al.* (2017) [18] and Bandari *et al.* (2021) [19].

The dry weight of bulb ranged from 7.75 to 15.10 percent, with a mean of 10.85 percent. The maximum dry weight of bulb was recorded in genotype ROG 17 (15.10%) while, the minimum dry weight of bulb was recorded in genotype RO 654 (7.75 Per cent). Singh *et al.* (2013) [7] and Bandari *et al.* (2021) [19] reported that the similar results. The chlorophyll content of onion genotypes was affected significantly. The minimum chlorophyll content (0.52 mg/g) was observed in the ROG 20 genotype of onion. However, the maximum chlorophyll content was recorded in RO 35 (1.24 mg/g).

Highly significant variation observed in pungency content and results show ranges from 1.36 to 8.62 µmol pyruvic acid/g fresh weight. ROG 34 (8.62 µmol pyruvic acid/g fresh weight) had showed that the highest pungency content followed by ROG 32 (8.60 µmol pyruvic acid/g fresh weight), ROG 35 (8.44 µmol pyruvic acid/g fresh weight), ROG 26 (8.43 µmol pyruvic acid/g fresh weight), ROG 39 (8.31 µmol pyruvic acid/g fresh weight), ROG 23 (8.30 µmol pyruvic acid/g fresh weight) and ROG 03 (8.29 µmol pyruvic acid/g fresh weight) while lowest pungency content was found in RO 1 (6.41 µmol pyruvic acid/g fresh weight). Manjunathagowda *et al.* (2019) [5] reported similar results.

Bulb yield is a composite character and is dependent on many constituent traits. Any change in these constituent traits would reflect on total yield. In terms of total yield, there was substantial heterogeneity among genotypes. The general mean for total yield was 335.77 q ha^{-1} and it ranged from 197.15 to 436.14 q ha^{-1}. The highest marketable yield was recorded in ROG 29 (436.14 q ha^{-1}) followed by ROG 32 (427.21 q ha^{-1}), ROG 45 (417.78 q ha^{-1}) and RO 645 (403.24 q ha^{-1}) and these genotypes were found at par with each other. The genotype RO 252 (197.15 q/ha) had the lowest marketable yield. The variation in yield might have been due to average weight of bulb, diameter of bulbs, genetic nature and environmental factor. Similar finding was reported by Pavlovic *et al*. (2003) [15], Thingalmaniyan *et al.* (2017) [18], Manjunathagowda *et al.* (2019) [5] and Bandari *et al.* (2021) [19].

Based on the present results, it can be concluded that the onion genotypes studied can be easily differentiated from one another due to their distinctive morphological characters and their performance. The genotypes ROG 29, ROG 32, ROG 45 and RO 645 can be utilized as potent parents in an appropriate breeding programme to improve total bulb yield and quality characters of onion. It is however recommended that further investigation on the yield performance and nutritional quality of the varieties be evaluated across different locations with varied ecology in Rajasthan.

Table 1: Mean values of plant height, number of leaves per plant, bolting and days to harvesting in different genotypes of onion

Genotypes	Plant height (cm)	Number of leaves per plant	Bolting (%)	Days to harvesting	Neck thickness (cm)	Polar diameter (cm)	Equatorial diameter (cm)	Average bulb weight (g)
RO 1	44.52	8.27	1.01	125.00	0.26	5.55	4.64	57.13
RO 59	47.26	8.13	3.33	123.64	0.27	4.65	4.90	52.40
RO 252	42.55	5.60	0.00	123.65	0.28	3.27	4.22	31.27
ROG 282	45.00	8.67	0.00	122.95	0.30	3.87	4.37	40.27
ROG 03	45.41	6.00	4.20	125.95	0.35	4.15	5.05	55.67
ROG 06	48.81	6.00	15.22	123.95	0.42	4.51	5.16	55.47
ROG 07	42.88	8.27	3.91	122.59	0.42	5.56	4.58	48.07
ROG 08	47.82	6.93	4.93	123.97	0.44	3.84	5.15	60.53
ROG 14	35.98	11.67	0.43	125.95	0.39	4.60	5.04	59.07
ROG 16	59.33	9.33	1.16	127.15	0.32	5.21	5.78	66.55
ROG 17	41.83	8.20	2.90	126.95	0.32	4.12	4.97	59.33
ROG 20	48.89	11.13	1.59	126.48	0.30	4.15	6.01	77.71
ROG 21	34.63	6.27	4.06	124.36	0.32	4.52	5.38	62.27
ROG 22	34.65	9.60	2.90	127.41	0.40	4.26	4.65	54.87
ROG 23	44.36	6.20	6.23	126.47	0.26	4.01	3.08	41.27
ROG 26	37.39	6.67	0.00	126.36	0.39	4.56	4.22	39.00
ROG 29	49.79	10.80	0.72	126.47	0.33	5.59	5.44	65.74
ROG 32	47.99	6.93	8.55	125.64	0.33	3.97	4.65	66.99
ROG 34	48.33	11.20	3.19	124.58	0.32	4.57	4.60	54.53
ROG 35	45.68	11.75	5.07	123.95	0.53	4.44	4.17	33.07
ROG 39	51.27	9.93	0.00	125.98	0.40	4.63	4.71	48.73
ROG 44	49.46	11.33	2.32	125.18	0.35	4.34	5.28	63.19
ROG 45	40.57	10.17	7.25	123.64	0.30	5.30	6.19	72.11
ROG 46	42.08	11.13	0.00	124.98	0.32	4.86	4.83	59.93
ROG 47	27.00	6.13	3.77	122.95	0.41	4.77	6.55	47.87
RO 645	44.42	5.66	0.00	125.98	0.20	3.61	6.70	80.47
RO 654	43.23	7.33	0.00	125.65	0.21	4.64	3.75	64.61
Rasidpur	47.32	9.60	0.00	129.97	0.59	2.61	5.05	52.13
Agrifound Dark Red	34.39	5.73	0.00	129.95	1.33	5.24	4.63	47.13

Bhima Shakti	47.28	11.40	0.00	132.80	1.12	4.56	4.51	52.00
S.Em±	1.87	0.33	0.10	0.82	0.02	0.19	0.19	2.16
CD (p=0.05)	5.30	0.92	0.28	2.33	0.05	0.54	0.54	6.11
C.V.(%)	7.37	6.63	6.28	1.13	7.79	7.43	6.71	6.72

Table 5: Mean values of pungency, sulphur content and total bulb yield studied in different genotypes of onion

Genotypes	Marketable bulb yield (q/ha)	Total soluble solids (0Brix)	Dry weight (%)	Chlorophyll content (mg/g)	Pungency (µ mol pyruvic acid/g fresh weight)	Total bulb yield (q/ha)
RO 1	340.54	14.92	9.27	1.10	6.41	343.59
RO 59	278.59	11.25	10.95	1.22	6.82	283.82
RO 252	189.90	12.54	13.10	0.73	6.49	197.15
ROG 282	245.62	12.47	11.54	0.82	7.40	253.90
ROG 03	305.42	10.25	9.81	1.19	8.29	351.01
ROG 06	244.92	9.45	12.29	0.69	8.08	349.75
ROG 07	268.66	12.47	9.69	1.03	7.39	303.09
ROG 08	327.07	11.25	11.74	1.22	6.44	381.70
ROG 14	344.41	9.41	13.25	0.60	8.39	372.45
ROG 16	363.15	14.65	9.41	0.90	6.58	390.00
ROG 17	334.40	13.65	15.10	0.97	8.10	374.13
ROG 20	378.47	8.22	9.40	0.52	8.33	397.09
ROG 21	341.94	8.60	9.45	1.15	6.71	392.63
ROG 22	306.11	12.10	10.47	1.07	6.89	345.96
ROG 23	216.31	11.57	9.31	0.79	8.30	260.21
ROG 26	202.80	12.95	13.41	0.85	8.43	245.92
ROG 29	390.25	11.11	10.28	1.07	8.57	436.14
ROG 32	351.59	11.98	8.97	0.71	8.60	427.21
ROG 34	304.20	12.21	12.20	1.05	8.62	343.86
ROG 35	170.33	11.84	12.28	1.24	8.44	240.03
ROG 39	282.69	10.98	9.70	0.63	8.31	307.29
ROG 44	353.35	12.34	9.63	0.93	8.10	375.14
ROG 45	383.77	11.43	8.40	0.90	7.41	417.48
ROG 46	359.41	12.10	11.83	0.54	7.81	270.58
ROG 47	263.55	14.17	13.69	0.85	7.43	301.83
RO 645	384.04	11.31	9.48	1.04	7.59	403.24
RO 654	322.71	11.25	7.75	1.02	8.15	323.26
Rasidpur	317.86	9.44	10.77	0.92	6.91	359.58
Agrifound Dark Red	287.44	12.65	9.22	0.84	7.10	297.20
Bhima Shakti	316.86	13.01	13.02	1.18	8.19	327.89
S.Em±	13.62	0.30	0.38	0.03	0.14	16.57
CD (p=0.05)	38.55	0.85	1.08	0.09	0.40	46.91
C.V.(%)	7.71	4.43	6.12	5.92	3.19	8.55

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