Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(6): 2493-2497
Received: 06-09-2019
Accepted: 10-10-2019

DC Manjunathagowda
1. ICAR-Directorate of Onion and Garlic Research, Pune, Maharashtra, India
2. Department of Vegetable Science, College of Horticulture, Bengaluru, UHS, Bagalkot, Karnataka, India

M Anjannappa
Department of Vegetable Science, College of Horticulture, Bengaluru, UHS, Bagalkot, Karnataka, India

HB Lingaiah
ICAR-Emeritus Professor, College of Horticulture, Bengaluru, UHS, Bagalkot, Karnataka, India

ES Rao
Division of Vegetable Science, ICAR-Indian institute of Horticultural Research, Bengaluru, Karnataka, India

KS Shankarappa
Department of Plant Pathology, College of Horticulture, Bengaluru, UHS, Bagalkot, Karnataka, India

J Jayappa
Department of Entomology, College of Horticulture, Bengaluru, UHS, Bagalkot, Karnataka, India

Corresponding Author:
DC Manjunathagowda
1. ICAR-Directorate of Onion and Garlic Research, Pune, Maharashtra, India
2. Department of Vegetable Science, College of Horticulture, Bengaluru, UHS, Bagalkot, Karnataka, India

Performance of open pollinated onion (*Allium cepa* L.) genotypes under southern dry zone of Karnataka

DC Manjunathagowda, M Anjannappa, HB Lingaiah, ES Rao, KS Shankarappa and J Jayappa

Abstract
The performance of different onion genotypes were assessed and revealed the significance of their plant growth and bulb production ability during *kharif* season of year 2017, since it is on off season production, *kharif* onions do fetch higher market price, Meanwhile farmers get premium returns from *kharif* season onion crop. The utmost plant height (70.42 cm) recorded by the genotype COHBON18, the number of leaves noted maximum in the genotype COHBON01 (12.06), the maximum leaf length (60.92 cm) was recorded from the variety Bhima Super. The highest maximum leaf width (1.64 cm) and maximum stem girth (1.53 cm) was recorded from the genotype COHBON15. The lowest premature bolts (1.00%) and lowest split bulbs or double bulbs (1.50%) were recorded from the genotype COHBON34. The maximum equatorial diameter (57.25 mm) of bulbs was recorded from the genotype COHBON11. The maximum polar diameter (56.51 mm), maximum average bulb weight (86.46 g) of bulbs, maximum weight of five bulbs (432.30 g), maximum weight of ten bulbs (0.73 kg), maximum weight of twenty bulbs (5.70 kg) and maximum bulb yield per hectare (31.66 t/ha) was recorded from the variety Bhima Super and which was followed genotypes COHBON34 (28.70 t/ha) and COHBON27 (28.28 t/ha). In view of better yield performance, these genotypes were suitable for cultivation during *kharif* season. Thus, the genotypes can also be used as source of breeding material for further genetic improvement of onion.

Keywords: Onion, genotype, growth, yield

Introduction
Onion (*Allium cepa* L.) is a high volume and high value vegetable crop belongs to the family *Alliaceae*, and it is a prime member of the genus *Allium*. The daily dietary demand of onion has been increasing within India and abroad, due to its nutritional values of lacrimatic factor, source of antibiotic, anti-cholesterol, anti-cancer and quercetin antioxidant compound (Baghizadeh *et al*., 2009) [1]. Hence, the onion crop area has been increasing in India to meet the demand of culinary requirement. It is good potential crop for the farmer to generate their income, to improve their living standards, being under extensive cultivation by the large, medium, small and marginal farmers across the country, mainly Maharashtra (6.8mt), Madhya Pradesh (3.3mt) and Karnataka (2.8mt) are the leading states of onion production in India. It is a potent foreign exchange earning crop of India, the export worth was in the order of 3106.50 crore by exporting 2.42 million metric tons of bulbs, which is contributes up to 70 per cent share of export earnings among the vegetable commodities. India (21.56mt) is the leader in onion production after China (22.61 mt). But, the productivity of India (16.10 t/ha) has pretty low compared to USA (55.95 t/ha), Netherlands (49.70 t/ha), Iran (36.93 t/ha) and Egypt (36.58 t/ha) (NHB, 2017) [8].
India cultivable area has been largely covered with open pollinated varieties might be a major cause for low onion productivity compared to the other countries (Pathak and Gowda, 1993) [10]. The development of suitable breeding lines through genetic improvement of open pollinated lines is a prime need to increase the productivity. In onion, the success of high productivity is relay on efficient performance of crop for horticultural traits. The onion cultivars divulge wide genetic variation for yield performance and also which is influenced by varied agro-climatic conditions (Pandey, 1989) [9]. Hence, it is indispensable to collect the locally adopted genotype, cultivars and varietal population cultivated by the farmers and screening them to know the performance ability. Thus, the farmers are self-sufficient with their own seed, produced through back yard seed production with isolation. Hence, collection, evaluation and selection in the open pollinated population were the best option to increase the yield and productivity by adopting suitable breeding methods.

Furthermore, farmers can produce and maintain their own seed within their locality with isolation for sustainable seed production for further subsequent bulb production with inexpensive of seed production costs.

An experiment was carried during *kharif* 2017 at Vegetable Research Block, Department of Vegetable Science, College of Horticulture (CoH), Bengaluru, University of Horticultural Sciences (UHS), Bagalkot, Karnataka, India. As per the Randomized Complete Block Design (RCBD) with two replications along with thirty open pollinated genotypes. Performance of genotypes was compared with the check variety Bhima Super. The experiment laid of plots of size of 1.5m×1.2m with spacing of 15cm × 10cm for bulb crop. Crop production and management practice were performed with the guide lines of UHS, Bagalkot package of practice (UHS, 2013). The observations recorded at were subjected for statistical analysis. The analyses of variance (ANNOVA) for RCBD are performed with use of OPSTAT open access software and results are interpreted with significance at five per cent (Sheoran *et al*., 1998) [14].

The appraisal of diverse genotypes of onion an imperative task to find out suitable genotypes for successful cultivation during *kharif* season, since *kharif* is an off-season cultivation of onion, standardization of genotypes for *kharif* cultivation has massive utility. The trial data on plant growth traits of onion genotypes are differed significantly during *kharif* season of 2017 were presented in Table 1. The plant height (70.42cm) was maximum in the genotype COHBON18 and it was on equivalence to the genotypes COHBON01 (67.36cm), COHBON09 (65.82cm), COHBON23 (64.74cm), COHBON25 (63.58cm), COHBON19 (62.69cm) HS0021 (62.59cm), COHBON17 (61.80cm), COHBON14 (61.08cm) and the variety Bhima Super (68.93cm). The maximum number of leaves were evidenced in the genotype COHBON01 (12.06) and which was likeness with the genotypes COHBON15 (11.15), COHBON02 (11.00) and COHBON34 (10.60). The maximum leaf length (60.92cm) was confirmed in the variety Bhima Super and it on par to the genotypes COHBON18 (60.25cm), COHBON09 (60.03cm), COHBON23 (57.54cm), COHBON19 (55.83cm), COHBON14 (55.16cm), COHBON25 (53.66cm), COHBON15 (53.09cm), COHBON27 (52.99cm), COHBON17 (52.40cm) and COHBON21 (51.78cm). The maximum leaf width (1.64cm) was witnessed by the genotype COHBON15 and which was equivalence with the genotypes COHBON17 (1.47cm), COHBON14 (1.43cm), COHBON01 (1.42cm), COHBON09 (1.41cm), COHBON21 (1.40cm), COHBON02 (1.38cm), and variety Bhima Super (1.54). The maximum stem girth (1.53cm) was noted in the genotype COHBON15, it was on equivalence with the genotypes COHBON18 (1.42cm), COHBON21 (1.38cm), COHBON19 (1.37cm), COHBON27 (1.32cm), COHBON14 (1.32cm), COHBON10 (1.32cm), COHBON12 (1.31cm), COHBON23 (1.31cm), COHBON09 (1.29cm), COHBON20 (1.29cm), COHBON02 (1.28cm), COHBON34 (1.28cm), COHBON25 (1.27cm), and variety Bhima Super (1.45cm). The vigorous plant height, more number of leaves, longer leaf length, wider leaf width and larger stem girth could be due to the inherent capacity of genotype, the innate capabilities to response for the higher photosynthetic activity, it might cause for more assimilation of photosynthesis, which intern cause for vigorous growth of onion plants. The plant vigor may also attributed due to genetic make-up of different local cultivars and prevailing environmental conditions of their cultivation, agronomical factors might stimulate the genes responsible growth of plants (Trivedi and Dhumal, 2010; Hosamani *et al.*, 2010; Khosa *et al.*, 2013; Tripathy *et al.*, 2013; Umamaheswarappa *et al.*, 2015; Bindu and Bindu, 2015; Utagi *et al.*, 2015; Lakshmipathi, 2016; Suhas, 2016; Ratan *et al.*, 2017) [17, 3, 5, 16, 19, 2, 20, 6, 15, 11].

The productivity influenced by the qualitative and quantitative traits, these traits are directly associated with bulb yield. The investigational facts for bulb yield and yield attributing traits are differed significantly during *kharif* season of 2017 documented in Table 2 and Table 3. The lowest premature bolts leads to the higher bulb yield, which were authenticated in the genotype COHBON34 (1.00%) at parity with variety Bhima Super (1.00%), it was followed by the genotype COHBON27 (1.50%). The bolting in onion mainly depends on genotype, temperature, soil condition, cultivation practices and seasonal effect during crop growth, the selection intensity might reduce the premature bolting incidence, the varied bolting percentage differed among the different among the genotypes. The lowest split bulbs or double bulbs in tern cause for increasing the bulb yield, which were recorded from the genotype COHBON34 (1.50%), it was at par with variety Bhima Super (1.50%), it was on par with the genotype COHBON27 (2.00%). The least production of split bulbs, or double bulbs mainly depends on the strong selection intensity of genotype, which is of free from split bulb and doubles during the process of breeding, climatic weather conditions of crop cultivation and agronomic practices imposed on crop production (Trivedi and Dhumal, 2010; Umamaheswarappa *et al.*, 2015; Suhas, 2016; Khar *et al.*, 2007; Yadav *et al.*, 2009) [17, 19, 15, 4, 21].

Increase in bulb size could cause for augmentation of bulb yield, the maximum polar diameter (56.51 mm) of bulb was proved in the variety Bhima Super, and it was on parity with the genotype COHBON02 (56.11 mm). The maximum equatorial diameter (57.25mm) of bulbs were documented from the genotype COHBON11, it was on par to the genotypes COHBON18 (56.61 mm), COHBON02 (55.61 mm) and COHBON32 (55.47 mm). The varied diameters of the bulb could be due to the influence of genotypic characters, the increased bulb morphological characters resulted by the photosynthetic activity, efficient translocation and assimilation of photosynthesis in the bulb could lead to enlargement of bulb horizontally as well as vertically depending upon the genotypes, as these components influence the weight of the bulb, which ultimately contributes to the yield (Hosamani *et al.*, 2010; Tripathy *et al.*, 2013; Umamaheswarappa *et al.*, 2015; Bindu and Bindu, 2015; Lakshmipathi, 2016; Khar *et al.*, 2007; Yadav *et al.*, 2009; Sharma, 2009) [3, 16, 19, 2, 6, 4, 21].

Amplification of bulb weight lead to the increased yield of onion among varied genotypes, the maximum average bulb weight (86.46 g) were indicated in the variety Bhima Super, and which was on equivalent to the genotypes COHBON05 (85.72 g) and COHBON18 (80.92 g). The maximum weight of five bulbs (432.30 g) were recorded from the variety Bhima Super, and which was on similarity with the genotypes COHBON18 (404.62 g), COHBON27 (403.49 g) and COHBON23 (402.29 g). The maximum weight of ten bulbs were verified from the variety Bhima Super (0.73 kg), and which was on similarity with the genotypes COHBON23 (0.71 kg), COHBON27 (0.70 kg) and COHBON34 (0.69 kg). The maximum weight of twenty bulbs (1.56 kg) were evidenced in the variety Bhima Super, and which was on par with the genotypes COHBON27 (1.48 kg), COHBON34 (1.43 kg) and COHBON23 (1.42 kg). The maximum plot yield

(5.70 kg) was witnessed in the variety Bhima Super, and which was followed genotypes COHBON34 (5.16 kg) and COHBON27 (5.09 kg). The maximum yield per hectare (31.66 t/ha) was recorded from the variety Bhima Super, and which was pursued by the genotypes COHBON34 (28.70 t/ha) and COHBON27 (28.28 t/ha). The maximum bulb weight might be due to genetically inherited traits, innate traits were might influenced on photosynthetic activity and mobility of availed nutrient to the plant, which might have directly influence on the bulb yield. The maximum growth and production of bulbs could be attributed by the plant vigor and genetic architecture of the genotypes, as this helped in better synthesis and accumulation of photosynthesis in the bulbs, which may be due influenced on efficient plant growth and developmental metabolism for greater mobilization of photosynthesis and better mobility of nutrients from source to sink (Sharma, 2009) [13]. The disparity in the bulb yield could be attributed by weight and size of different onion genotypes, reduced premature bolt, split or double bulbs; higher polar and equatorial diameter of bulbs might be contributed towards the production of higher bulb yield per plot in terms of yield per hectare (Trivedi and Dhumal, 2010; Bindu and Bindu, 2015; Lakshmipathi, 2016; Sharma, 2009; Mahanthesh *et al.*, 2008; Yasmin, 2009; Sahu, 2017) [17, 2, 6, 13, 7, 22, 12].

The bulb yield was revealed to be superior with *var*. Bhima Super, since it is genetically improved variety and released for commercial cultivation. The genotypes COHBON02, COHBON05, COHBON11, COHBON18, COHBON23, COHBON27 and COHBON34 (Figure 1) are locally cultivated by farmer by producing their own seeds through open pollination. However their performance is found to be better in term bulb yielding traits. Hence further their seed production should be done under isolation to maintain the genetic purity of seed, it may be lead to the commercial cultivation of these genotypes and theses genotypes can be used for further genetic improvement of onion as parental lines.

Table 1: Estimates of vegetative plant growth parameters of different onion genotypes during *kharif* 2017

Treatment	Plant height (cm)	Number of leaves	Maximum leaf length (cm)	Maximum leaf width (cm)	Stem girth (cm)
COHBON01	67.36	12.06	58.64	1.42	1.14
COHBON02	57.85	11.00	50.60	1.38	1.28
COHBON03	53.11	10.13	46.54	1.19	0.91
COHBON04	57.49	11.90	50.72	1.23	1.12
COHBON05	51.85	9.90	47.06	1.31	1.11
COHBON06	53.81	10.90	46.28	1.29	1.09
COHBON07	53.10	10.70	47.20	1.18	1.20
COHBON08	55.06	9.40	48.21	1.13	1.16
COHBON09	65.82	8.80	60.03	1.41	1.29
COHBON10	57.03	9.30	51.30	1.27	1.32
COHBON11	49.64	9.00	43.79	1.03	1.21
COHBON12	58.07	9.20	49.58	1.23	1.31
COHBON14	61.08	9.30	55.16	1.43	1.32
COHBON15	59.88	11.15	53.09	1.64	1.53
COHBON17	61.80	10.75	52.40	1.47	1.05
COHBON18	70.42	10.10	60.25	1.37	1.42
COHBON19	62.69	9.90	55.83	1.29	1.37
COHBON20	54.94	11.40	44.81	1.25	1.29
COHBON21	62.59	10.00	54.58	1.40	1.38
COHBON22	59.47	10.20	51.78	1.33	1.20
COHBON23	64.74	9.10	57.54	1.28	1.31
COHBON24	52.37	10.46	43.29	0.86	1.09
COHBON25	63.58	8.00	53.66	0.94	1.27
COHBON26	57.14	8.41	48.44	0.88	1.17
COHBON27	60.27	9.20	52.99	1.36	1.32
COHBON28	50.98	9.52	44.41	1.41	1.17
COHBON32	56.69	8.60	50.60	1.11	1.07
COHBON33	53.02	9.30	45.81	1.16	0.97
COHBON34	58.19	10.60	51.04	1.20	1.28
COHBON35	53.58	8.80	47.18	1.31	1.23
Bhima Super	68.93	9.70	60.92	1.54	1.45
S.E.±m	3.27	0.52	3.09	0.09	0.10
C.D. at 0.05	9.48	1.51	8.96	0.26	0.29
C.V. (%)	7.90	7.43	8.54	10.06	11.41

Table 2: Estimates of earliness and yield attributing traits of different onion genotypes during *kharif*-2017

Treatment	Neck fall (50%)	Neck fall (75%)	Premature bolts (%)	Split bulbs (%)	Polar diameter (mm)	Equatorial diameter (mm)
COHBON01	111.00	114.50	5.50	4.50	52.56	54.25
COHBON02	102.00	105.00	6.00	6.00	56.11	55.67
COHBON03	95.50	100.00	10.00	9.00	43.71	42.67
COHBON04	104.50	107.00	3.50	5.50	43.66	41.31
COHBON05	113.50	117.00	4.50	4.50	37.05	47.53
COHBON06	95.00	97.00	7.50	8.50	43.48	47.91
COHBON07	94.50	96.50	8.50	4.50	37.61	40.86
COHBON08	105.00	107.50	6.50	5.00	53.60	53.71

COHBON09	92.50	95.50	10.00	7.00	50.94	50.76
COHBON10	94.00	95.50	7.00	6.50	46.11	49.31
COHBON11	95.50	97.50	13.50	11.00	52.14	57.25
COHBON12	94.00	96.50	14.00	13.50	43.83	48.84
COHBON14	96.00	100.00	10.50	7.50	44.07	47.57
COHBON15	92.00	93.50	7.50	6.50	37.24	39.71
COHBON17	94.00	95.50	7.50	7.50	37.83	43.94
COHBON18	108.00	112.00	8.00	8.50	52.19	56.61
COHBON19	97.50	99.50	4.50	4.50	42.78	50.86
COHBON20	93.50	95.00	14.50	14.50	38.46	42.25
COHBON21	97.50	102.00	8.00	10.00	43.44	52.97
COHBON22	93.00	95.50	8.00	7.50	46.76	46.49
COHBON23	106.50	116.00	4.50	4.50	40.28	40.64
COHBON24	94.50	99.50	8.50	10.50	45.91	44.37
COHBON25	92.50	94.50	8.00	8.00	51.85	53.06
COHBON26	92.50	95.00	8.00	9.50	44.19	46.07
COHBON27	109.00	115.50	1.50	2.00	42.08	41.00
COHBON28	95.50	98.50	10.00	11.00	44.86	46.81
COHBON32	93.50	96.50	7.00	7.50	52.20	55.47
COHBON33	91.50	93.00	8.50	10.00	38.19	39.45
COHBON34	102.00	106.50	1.00	1.50	48.44	54.75
COHBON35	98.50	105.50	11.50	12.50	50.64	51.95
Bhima Super	113.50	117.00	1.00	1.50	56.51	50.58
S.E.±m	1.05	1.05	0.83	0.76	0.74	0.78
C.D. at 0.05	3.05	3.06	2.41	2.20	2.14	2.27
C.V. (%)	1.51	1.46	15.49	14.39	2.28	2.29

Table 3: Estimates of yield parameters of different onion genotypes during *kharif*-2017

Treatment	Average bulb weight (g)	Weight of 5 bulbs (g)	Weight of 10 bulbs (kg)	Weight of 20 bulb (kg)	Plot yield (kg)	Yield/ha (t)
COHBON01	77.64	388.20	0.54	1.22	4.53	25.15
COHBON02	65.60	328.01	0.52	0.99	4.10	22.74
COHBON03	38.55	192.75	0.44	0.79	3.49	19.36
COHBON04	65.90	329.49	0.54	0.75	4.49	24.92
COHBON05	85.72	428.60	0.31	0.58	4.46	24.74
COHBON06	49.70	248.50	0.32	0.64	3.87	21.51
COHBON07	55.36	276.80	0.43	0.62	4.13	22.96
COHBON08	77.95	389.76	0.51	0.92	4.27	23.69
COHBON09	35.38	176.90	0.47	0.88	3.84	21.34
COHBON10	41.73	208.65	0.43	0.76	4.12	22.89
COHBON11	44.98	224.90	0.34	0.69	3.79	21.03
COHBON12	53.55	267.75	0.36	0.81	3.41	18.91
COHBON14	51.21	256.06	0.43	0.91	3.82	21.21
COHBON15	37.66	188.30	0.35	0.65	3.97	22.05
COHBON17	42.86	214.30	0.39	0.74	4.06	22.53
COHBON18	80.92	404.62	0.35	0.84	3.85	21.37
COHBON19	61.43	307.15	0.49	1.10	4.64	25.78
COHBON20	44.87	224.35	0.31	0.74	3.18	17.65
COHBON21	64.70	323.50	0.41	1.01	3.76	20.88
COHBON22	47.39	236.95	0.44	0.83	4.17	23.17
COHBON23	80.46	402.29	0.71	1.42	4.88	27.13
COHBON24	53.45	267.23	0.42	0.72	3.44	19.10
COHBON25	44.64	223.20	0.38	0.97	3.89	21.59
COHBON26	45.64	228.19	0.45	1.11	4.01	22.24
COHBON27	80.70	403.49	0.70	1.48	5.09	28.28
COHBON28	51.24	256.21	0.28	0.65	3.65	20.25
COHBON32	45.95	229.76	0.48	0.74	3.89	21.60
COHBON33	37.74	188.70	0.33	0.97	3.65	20.24
COHBON34	76.54	382.70	0.69	1.43	5.16	28.70
COHBON35	66.26	331.30	0.36	0.89	3.28	18.24
Bhima Super	86.46	432.30	0.73	1.56	5.70	31.66
S.E.±m	2.30	11.52	0.03	0.05	0.17	0.96
C.D. at 0.05	6.68	33.42	0.09	0.14	0.50	2.79
C.V. (%)	5.63	5.63	10.24	7.50	5.99	6.00

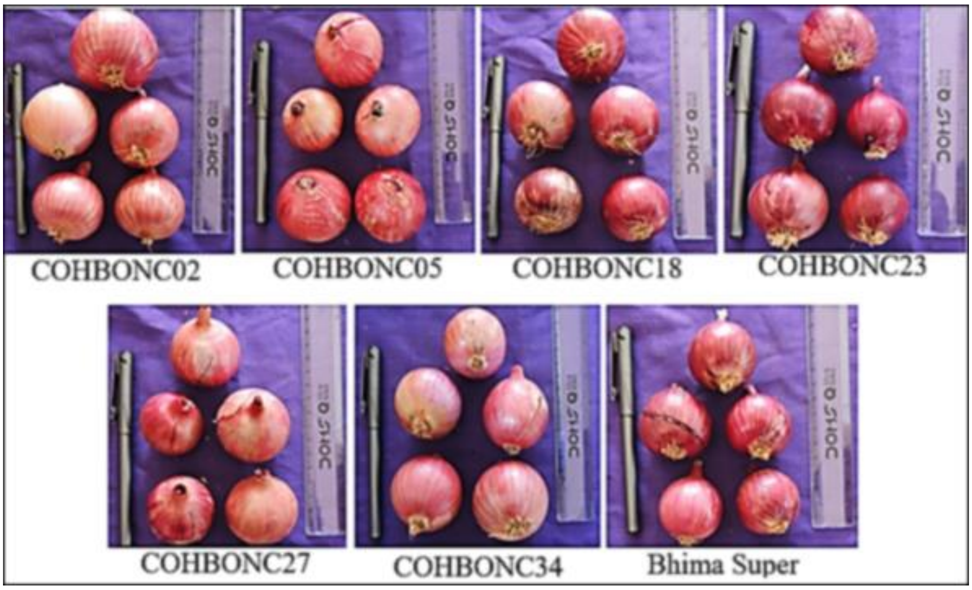

Fig 1: Superior bulb yielding onion genotypes of *kharif* season 2017

Reference

1. Baghizadeh A, Baniasadi F, Bonjar GHS, Sirchi GRS, Massumi H, Jorjandi M *et al*. Biocontrol of *Botrytis allii* Munn the causal agent of neck rot, the post-harvest disease in onion, by use of a new Iranian isolate of *Streptomyces*. American J Agric. Biol. Sci. 2009; 4:72-78.
2. Bindu B, Bindu P. Performance evaluation of onion (*Allium cepa* L.) varieties for their suitability in Kollam district. Int. J Res Studies Agric. Sci. 2015; 1(1):18-20.
3. Hosamani RM, Patil BC, Ajjappalavara PS. Genetic variability and character association studies in onion (*Allium cepa* L.). Karnataka J Agric. Sci. 2010; 23(2):302-305.
4. Khar A, Devi A, Mahajan V, Lawande KE. Stability analysis of some elite onion lines in late *Kharif* season. Indian J Hort. 2007; 64:32-36.
5. Khosa JS, Dhatt AS, Neg KS. Morphological characterization of *Allium* spp. using multivariate analysis. Indian J Plant Genet Resour. 2013; 27(1):24-27.
6. Lakshmipathi N. Studies on collection and evaluation of onion landraces *(Allium cepa* L). M.Sc. (Hort.) Vegetable Science, Thesis, University of Horticultural Sciences, Bagalkot, 2016.
7. Mahanthesh B, Ravi PSM, Harshavardhan M, Vishnuvardhana, Janardhan G. Evaluation of different onion (*Allium cepa* L.) genotypes for yield and processing quality parameters in kharif season under irrigated condition. The Asian J Hort. 2008; 3(1):5-9.
8. NHB. National Horticultural Board, Horticultural Statistics at a Glance, 2017, 209-407. http://nhb.gov.in/statistics/Publication/Horticulture.
9. Pandey UB. Onion (*Allium cepa* L.) varietal trial. Indian Hort. 1989; 33:58-62.
10. Pathak CS, Gowda RV. Breeding for the development of onion hybrids in India: Problems and prospects. Acta Hortic. 1993; 358:239-242.
11. Ratan D, Veere Gowda R, Pandey H. Evaluation of different onion (*Allium cepa* L.) genotypes for yield and quality parameters in kharif season under bengaluru condition. Int. J Curr. Microbiol App Sci. 2017; 6(11):2393-2398. DOI: doi.org/10.20546/ijcmas.2017.611.283
12. Sahu K. Evaluation of *Kharif* onion genotypes under Chhattisgarh plains condition. M.Sc. Horticulture, Thesis. Indira Gandhi Krishi Vishwa Vidyalaya, Raipur, Chhattisgarh, 2017.
13. Sharma AK. Evaluation of onion varieties in *Kharif* season under submontane low hill conditions of Himachal Pradesh. Ann Hort. 2009; 2(2):191-193.
14. Sheoran OP, Tonk DS, Kaushik LS, Hasija RC, Pannu RS. Statistical Software Package for Agricultural Research Workers: Recent Advances in information theory. Hooda DS, Hasija RC Statistics and Computer Applications, Department of Mathematics Statistics, CCS HAU, Hisar, 1998, 139-143. http://14.139.232.166/opstat/.
15. Suhas YH. Studies on performance of varieties, F_1 hybrids and synthetics of onion in eastern dry zone of Karnataka. M.Sc. (Hort.) Vegetable Science, Thesis, University of Horticultural Sciences, Bagalkot, 2016.
16. Tripathy P, Priyadarshini SK, Das BB, Sahoo Dash DK. Evaluation of onion (*Allium cepa* L.) genotypes for tolerance to thrips and purple blotch. Inter J Bioreso Stress Manage. 2013; 4(4):561-564.
17. Trivedi AP, Dhumal KN. Variability and correlation studies on bulb yield, morphological and storage characters in onion (*Allium cepa* L.). J Pure Appl. Sci. 2010; 18:1-4.
18. U.H.S. University of Horticultural Sciences, Bagalkot, Karnataka, Package of practice: onion, 2013, 111-114. http://uhsbagalkot.edu.in/downloads/Horticulture_POP.pdf.
19. Umamaheswarappa P, Naik AH, Nataraja M. Evaluation of onion genotypes for growth, yield and quality parameters under central dry zone of Karnataka. Environ Ecol. 2015; 33(2):992-995.
20. Utagi S, Anjanappa M, Muthal KM, Badiger M. Evaluation of onion (*Allium cepa* L.) cultivars during late *Kharif* season. Ecology, Environment and Conservation Paper. 2015; 21:95-99.
21. Yadav SS, Haldavanekar PC, Bhave SG, Khandekar RG, Haldankar PM. Growth and yield performances of onion varieties under Konkan agro-climatic conditions of Maharashtra. J Asian Hort. 2009; 5(2):85-86.
22. Yasmin N. Morphological characterization and genetic diversity of onion (*Allium cepa* L.). M.Sc. Genetics and Plant Breeding, Thesis. Sher-E-Bangle Agricultural University, Dhaka, 2009.