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Studies on genetic variability of onion on growth, yield and quality parameters

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Abstract
The present study was conducted to know genetic variability for yield and quality attributes in onion (*Allium cepa*. L) at ICAR-KVK, Hagari, Benchi Kottal, Ballari, during *rabi* (2020-21) with thirty two onion genotypes with three replication in order to generate information regarding the extent of genetic variability, heritability, genetic advance as percent mean. High degree of variation was observed for all the characters studied. Phenotypic co-efficient of variance (PCV) in general was higher than genotypic co-efficient of variance (GCV) and also the difference is small and which reflects the role of environment is very less. Genotypic coefficient of variation varied from 5.66% (number of leaves per plant) to 45.93% (leaf area and leaf area index). Phenotypic coefficient of variation varied from 9.31% (days to maturity) to 48.72% (leaf area and leaf area index) for various character studied. High estimates of heritability found for all the characters except number of leaves per plant and total soluble solids. Genetic advance as percent mean was observed high for all characters except number of leaves per plant, days to maturity and total soluble solids. The characters are governed by additive gene effects. Selection on the basis of the characters will be more useful for the crop improvement of the crop towards attaining higher yield.

Keywords: Heritability, additive gene, onion, co-efficient of variance

Introduction
Onion (*Allium cepa* L.) is a prime vegetable crop of the genus *Allium* belongs to the family Amaryllidaceae under order Asparagales having chromosome number 2n (2x) =16. It is confounded to be originated from Central Asia as center of origin and near East and Mediterranean regions are considered as secondary centers of origin (Vavilov, 1926 and McCollum, 1976) [14, 9]. Onions are used as raw in the form of salad, vegetable and spice all over the world (Katyal, 1985) [7]. The bulb and greens are rich in vitamin C, dietary fiber, mineral potassium, folic acid and it is richest source of mineral vanadium. It is also contains calcium, iron and high quality protein with low sodium without fat (Roshania and Agrawal, 1981) [12]. Onion bulb contains 86.80 per cent of moisture, 11.00 g of carbohydrates, 1.20 g of protein, 0.60 g of fiber, 0.08 mg of thiamine, 11.00 mg of vitamin C, 180.00 mg of calcium, 50.00 mg of phosphorus, 0.70 mg of iron, 0.40 mg of nicotinic acid and 0.01 mg of riboflavin per 100.00 g of edible portion (Nadkarni, 1993) [10]. The onion is significantly differed from other *Allium* species with shape, size, colour, flavor and other characters of bulbs and foliage. Onion has strong flavor due to presence of sulphur containing compound "allyl propyl disulphide" responsible for distinctive smell and pungency. Highly pungent red coloured onions are preferred in India, the yellow colour in onion is due to the presence of another pigment "quercetin" and red colour in onion is due to the presence of another pigment "anthocynin". India is the second largest producer of onion in the world after china and occupies an area of 1,431.38 thousand hectares and production of 26,091.38 thousand metric tons with productivity of 18.23 t/ha. Maharashtra is the leading state in cultivation of onion and occupies an area of 618 thousand hectare with the production of 10,683 thousand metric tons, however the highest productivity is recorded from Sikkim with 56.11 ton/ha (Anonymous 2019-20) [1]. In Karnataka, onion is cultivated in an area of 160.00 thousand hectares and production of 2,275.00 thousand metric tons with a productivity of 14.22 t/ha. (Anonymous, 2019-20) [1]. The major onion growing districts in Karnataka are Chitradurga, Dharwad, Gadag, Ballari and Belagavi. The purpose of breeding programme is to know the yield potential of a popular crop variety which are resistance to disease and pests which are being effectively used for determining the rate of various yield components in different crops, leading to the selection of superior genotypes.

Materials and Methods

The experiment was conducted at ICAR-KVK, Hagari, BenchiKottal, Ballari during *rabi* season 2020-2021 using thirty two onion genotypes collected at different places. Thirty two genotypes (Table 1) were taken for study. Seedlings of 40 days old were transplanted to the main field during *rabi* season. The experiment was laid out by adopting Randomized Block Design with three replications with a spacing of 15 cm x 10 cm. One thirty three plants per genotype per replication were maintained. Genotypic co-efficient of variation (GCV) and Phenotypic co-efficient of variation (PCV) was estimated using formula of Burtain and De vane (1953) and expressed in terms of percentage. Heritability was estimated using formula of Hanson *et al.* (1956) [5] and expressed in terms of percentage. Genetic advance as per cent of mean was given by Johnson *et al.* (1955) [6].

Table 1: List of genotypes (Treatment)

ONVC-1	ONVC-12	ONVC-23
ONVC-02	ONVC-13	ONVC-24
ONVC-03	ONVC-14	ONVC-25
ONVC-04	ONVC-15	ONVC-26
ONVC-05	ONVC-16	ONVC-27
ONVC-06	ONVC-17	ONVC-28
ONVC-07	ONVC-18	ONVC-29
ONVC-08	ONVC-19	ONVC-30
ONVC-09	ONVC-20	BALLARY RED
ONVC-10	ONVC-21	BHIMA SUPER
ONVC-11	ONVC-22	

Result and Discussion

The extent of variability with respect to various characters in different genotypes was measured in terms of range, mean, Genotypic co-efficient of variation (GCV),Phenotypic co-efficient of variation(PCV), heritability (h^2) and genetic advance as percent of mean (GAM) (Table 2).

Genotypic co-efficient of variation

The PCV was found to be greater than GCV for all the characters studied. Genotypic co-efficient of variation varied from 5.66% (number of leaves per plant) to 45.93% (leaf area and leaf area index).Total soluble solid (9.91%) followed by days to maturity (8.78%), number of leaves per plant (5.66%)all these parameters shown between 1-10 percent and refered as low GCV. Bulb shape index (19.89%) followed by leaf length (17.70%), longitudinal diameter of bulb (16.88%), plant height (16.29%), number of rings per bulb (14.49%) and dry matter of onion % (11.91%) these parameters showing between 10.1-20 percent and these characters refered as moderate GCV. Leaf area and leaf area index (45.93%) followed by average bulb weight (44.36%), total yield per plot and marketable yield per plot (37.59%), bulb neck thickness (26.88%), equatorial diameter of bulb(21.49%) and thickness of onion scale(20.63%) these parameters showing 20.1 and above percent and these characters refered as high GCV. The results are in conformation with Dangi *et al.* (2018) [4], Chatto *et al.* (2015) [3] and Lakshmi (2015) [8].

Phenotypic co-efficient of variation

Phenotypic coefficient of variation varied from 9.31% (days to maturity) to 48.72% (leaf area and leaf area index). Days to maturity (9.31%) parameters shown between 1-10 percent and this characters is refered as low PCV. Leaf length (19.88%) followed by longitudinal diameter of bulb (18.49%), plant height (18.23%), number of rings per bulb (16.42%), dry matter of onion % (13.92%), total soluble solids (13.36%) and number of leaves per plant (10.84%) these parameters showing between 10.1-20 percent and these characters refered as moderate PCV. Leaf area and leaf area index (48.72%) followed by average bulb weight (45.01%), bulb shape index (23.43%), thickness of onion scale (22.77%) and equatorial diameter of bulb (22.69%) these parameters showing between 20.1 and above percent and these characters refered as high PCV. These results are in agreement with Solanki *et al.* (2015) [13] and Chatto *et al.* (2018) [3].

Heritability Broad Sence

Heritability broad sense (%) of variation varied from 27.32% (number of leaves per plant) to 97.14% (average bulb weight). Number of leaves per plant (27.32%) parameter shown between 0-30 percent and this character refered as low heritability. This is indicative of the fact that this character is rather more influenced by the environment and may not respond much to selection. Total soluble solids (55.01%) parameter shown between 30.1-60 percent and this character refered as moderate heritability. Average bulb weight (97.14%) followed by total yield per plot (90.80%), marketable yield per hectare (90.80%), equatorial diameter of bulb (89.71%), days to maturity (88.96%), leaf area (88.89%), leaf area index (88.89%),bulb neck thickness (88.34%), longitudinal diameter of bulb (83.36%), thickness of onion scale (82.13%), plant height (79.85%), leaf length (79.29%), number of rings per bulb (77.89%), dry matter of onion % (73.26%) and bulb shape index (72.00%)these parameters showing 60.1 and above percent and these characters refered as high heritability. The results are in conformation with Solanki *et al.* (2015) [13], and Pujar *et al.* (2019) [11].

GAM (Genetic advance as per cent mean)

GAM variation varied from 6.10% (number of leaves per plant) to 90.06% (average bulb weight).Number of leaves per plant (6.10%) parameters shown between 1-10 percent and this characters is refered as low GAM. Days to maturity (17.05%) and total soluble solids (15.14%) these parameters showing between 10.1-20 percent and these characters refered as moderate GAM. Average bulb weight (90.06%) followed by leaf area (89.21%), leaf area index (89.21%), total yield per plot (73.79%), marketable yield per hectare (73.79%), bulb neck thickness (52.04%), equatorial diameter of bulb(41.93%), thickness of onion scale (38.52%), bulb shape index (34.76%), leaf length (32.47%), longitudinal diameter of bulb (31.75%), plant height(29.99%), number of rings per bulb(26.35%) and dry matter of onion % (21.00%) all these parameters showing20.1 and above percent and these characters refered as high GAM. The results are in accordance with the findings of Dangi *et al.* (2018) [4], and Chatto *et al.* (2015) [3].

Table 2: Estimates of variability, heritability and genetic advance as percent mean for different characters in onion genotypes

Sl. No	Characters	Range		Mean	GCV (%)	PCV (%)	h^2BS (%)	GAM (%)
		Min	Max					
1	Plant height (cm)	40.08	68.26	51.95	16.29	18.23	79.85	29.99
2	Number of leaves per plant	10.38	14.12	12.38	5.66	10.84	27.32	6.10
3	Leaf length (cm)	34.75	62.26	45.90	17.70	19.88	79.29	32.47
4	Leaf area (cm^2)	90.20	441.44	250.18	45.93	48.72	88.89	89.21
5	Leaf area index	0.68	3.32	1.88	45.93	48.72	88.89	89.21
6	Average bulb weight (g)	16.35	124.73	66.18	44.36	45.01	97.14	90.06
7	Longitudinal diameter of bulb (cm)	3.18	6.40	4.62	16.88	18.49	83.36	31.75
8	Equatorial diameter of bulb (cm)	2.63	7.24	5.30	21.49	22.69	89.71	41.93
9	Number of rings per bulb	6.58	12.72	10.15	14.49	16.42	77.89	26.35
10	Thickness of onion scale (mm)	0.22	0.45	0.31	20.63	22.77	82.13	38.52
11	Total yield perplot (kg/plot)	1.71	15.22	8.37	37.59	39.45	90.80	73.79
12	Marketable yield per hectare(t/ha)	8.54	76.11	41.85	37.59	39.45	90.80	73.79
13	Days to maturity	91.00	120.81	103.62	8.78	9.31	88.96	17.05
14	Total soluble solid (^{0}B)	9.35	13.76	11.65	9.91	13.36	55.01	15.14
15	Bulb neck thickness (cm)	0.33	1.09	0.77	26.88	28.60	88.34	52.04
16	Bulb shape index	0.66	1.46	0.90	19.89	23.43	72.00	34.76
17	Dry matter of onion (%)	11.70	17.55	13.85	11.91	13.92	73.26	21.00

GCV and PCV - 1-10 per cent (low), 10.1-20 per cent (moderate), 20.1 per cent and above (high)
Heritability (Broad sense) - 0-30 per cent (low), 30.1-60 per cent (moderate), 60.1 per cent and above (high)
GAM -0-10 per cent (low), 10.1-20 per cent (moderate), 20.1 per cent and above (high)
GCV-Genotypic co-efficient of variation h^2 BS-Broad sense heritability
PCV-Phenotypic co-efficient of variation GAM-Genetic advancement as percent of mean

Conclusion

High genetic variability in GCV and PCV indicating that characters offers great scope for selection due to high variation in genotypes. High heritability coupled with high GAM permits greater effectiveness for selection by separating out the environmental influence from total variability and thereby allowing the accurate selection of a potential genotypes.

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