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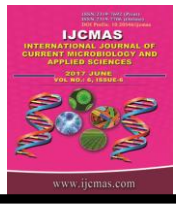

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Performance Evaluation of Aggregatum Onion Genotypes (*Allium cepa* Var. Aggregatum) for Yield, Quality and Resistance Characters

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A B S T R A C T

Field experiment were conducted involving 50 aggregatum onion (*Allium cepa* var. aggregatum) genotypes during 2012-13, 2013-14 and 2014-15 at the experimental field of College Orchard, Department of Vegetable Crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore to identify the elite aggregatum onion types for high yield and quality. Among the 50 aggregatum genotypes evaluated, significant variations were observed for all the traits viz., plant height (cm), leaves per plant, polar and equatorial diameter of bulbs (mm), average clump weight (g), bulb colour, total yield (t/ha) total soluble solids (°brix) thrips damage (%) and leaf spot incidence (PDI). The per se performance of germplasm revealed that Aca 15 have excelled in yield and contributing characters. On the basis of high *per se* performance, the potential germplasm Aca 15 (Puttarsal local) recorded the highest plant height of 38.40 cm, number of leaves (19.01), polar and equatorial diameter of bulbs was 39.52 and 42.06 mm, average clump weight (93.46 g), total yield (23.18 t/ha) and total soluble solids (18.69 °brix). Lesser incidence of thrips damage (9.1%) and leaf spot incidence (9.8%) were also recorded in Aca 15. This germplasm could be tested in different seasons over different locations for assessing their stability for high yield and quality.

Introduction

Onion (*Allium cepa* L.) belongs to the family Liliaceae, an important group of crops grown worldwide (Best, 2000). It is divided into three groups: *Allium cepa*, *Allium cepa* var. aggregatum, *Allium proliferum*, which are all diploids (2n = 2x = 16) (Boukary *et al.*, 2012).

The crop is a biennial herb of Central Asian origin (Afghanistan, Iran and Pakistan) and it is cultivated all around the world. Onion occupies 4th position in the world level after tomato, cabbage and watermelon with a global annual production of 25 million tonnes (Boukary *et al.*, 2012). 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 (Ado, 2001). It also contains vitamins viz., thiamine, riboflavin and niacin and is used for its medicinal value especially in the case of heart problems (Mettananda and Fordham, 2001).

The bulbs are major source of phytochemical called quercetin, which is effective in reducing the risk of cardiovascular disease, an

anti-cancerous, and has promise to be an antioxidant The bulbs are boiled and used in soups and stews, fried or eaten raw in salads. It is hardy, bulbous rooted plant with small narrow rounded leaves and a white flower. Onion possesses typical pungent flavoring and it is useful mainly as a spice, seasoning and flavoring agent for foodstuff. Eating of raw onion boost the immune system and regulate blood sugar level.

In fact, successful onion production depends mainly on the selection of varieties that are adapted to different conditions imposed by specific environment. In Tamil Nadu, aggregatum onion is the most popularly grown by farmers, both for home use and source of income. Therefore, the introduction of new varieties represents an important axe to enhance production by increasing the number of cultivars available for growers, which is not only an advantage for the farming community but also for markets and processing industries. The potato onion or aggregatum onion (*Allium cepa* var. aggregatum) is a member of the onion family that reproduces primarily by division of bulbs, rather than by seed. Potato onions are more commonly grown by replanting the bulbs than by seed. The major aggregatum onion growing states of India are Tamil Nadu, Karnataka and Orissa. In Tamil Nadu, it is extensively cultivated in Coimbatore, Palladam, Perambalur, Trichy and Dindugul districts.

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 (Boukary *et al.,* 2012). Ijoyah *et al.,* (2008) evaluate the yield performance of four onion varieties and found that some other varieties performed better than the commonly grown onion varieties by the farmers. Tesfay *et al.,* (2011) conducted an evaluation trial of three onion cultivars and concluded that onion cultivar performed differently and Parachinar local variety resulted in higher yield.

Hence, the present research was conducted to evaluate performance of fifty genotypes of aggregatum onion next to the commonly grown aggregatum onion varieties with the objective of identifying the variety/varieties with highest yield, quality, pest and disease resistant to replace or be used with the low yielding local variety under Tamil Nadu field conditions.

Materials and Methods

Field experiment was conducted in the college orchard, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore. The area is located on 11° N latitude and 77° E longitude and altitude of 426.26 m above mean sea level. The region belongs to sub tropical bioclimatic stage characterized by nice winter and cool summer. Fifty aggregatum onion germplasm were collected from various districts in Tamil Nadu and Gujarat. Details of the genotypes are furnished in table 1. These 50 genotypes were evaluated and studied for their growth, yield and quality performance based on morphological and agronomical measurements (Fig. 1). The trial was started

during 2012. Soil was cleared from weeds, rotovated and divided into beds on which well-decomposed farm yard manure was applied and incorporated manually into the soil. Each bed was divided into eight plots. The size of the plot was 3 m x1 m and the germplasms was planted in a randomized block design. The bulbs of each variety were sown on June 2012 -2014 in rows at spacing of 15 cm and a plant spacing of 10 cm in every variety is represented by 5 rows. Irrigation was done by drip irrigation and in advanced stage it was used for fertigation. Pre emergence weedicide spraying was done using pendimethalin 2 ml /lit of water, followed by manual weeding. Harvesting was done when a large portion of the leaves were dry. Observations were recorded from 10 randomly selected plants of each germplasm and in each replication. Biometrical parameter includes plant height (cm) and number of leaves. Bulb characteristics concerned polar diameter (mm), equatorial diameter (mm), average clump weight (g) and bulb colour. Yield and quality parameter like total yield (kg/ ha) and TSS (°Brix) were recorded. For identifying resistance sources, thrips damage and leaf spot incidence were also observed from 50 germplasms. The statistical parameters like mean, range were calculated as per the standard methods of analysis (Panse and Sukhatme, 1957).

Results and Discussion

Plant breeding programme of any crop aims at improving the existing types or evolving a new type which is superior to existing ones. Collection of genotypes from different geographical origin and evaluation for assessing the extent of variability are the first step in any crop improvement programme, as this offers a new broad genetic base population to make further selections (Robinson, 1965). To initiate selection and to facilitate varietal improvement, a study of yield related characteristics is a must. This will highlight the potentialities of wider varietal range either for direct introduction or to utilize these types as parents in future breeding programme.

In view of its potential cultivation in Tamil Nadu, the present investigation was carried out with fifty cultivars of multiplier onion, collected from different sources. They were evaluated for yield, quality, pest and disease resistance. The data on growth, yield and its contributing characters and pest and disease resistance traits of the different onion cultivars recorded during the 2012-13, 2013-14 and 2014-15 are pooled and presented in table 2.

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 multiplier onion.

Growth, Yield and Quality Characters

The plant height was measured at the maturity stage and average was computed.

The pooled analysis of three year data showed there was a significant difference on the plant height due to genotypes (Table 2). The highest plant height (38.70 cm) was observed in Aca 12 (Sulur Pink type -1) and it was found at a par with the genotype Aca 15 (38.40 cm) whereas the lowest plant height (22.10 cm) was recorded by Aca 3 (Dindigul type-1). Similar variability in plant height between varieties confirming there results were observed on onion (Ibrahim, 2010; Trivedi and Dhumal, 2010). According to Mohanty and Prusti (2001), the difference in height of the plant on onion is mainly attributed to the genetic potential but also to

environmental factors especially temperature and photoperiod (Tesfay *et al.*, 2011). These results of current investigation are in agreement with Azoom *et al.*, (2014). Number of leaves influences the yield to a significant extent also decide the spread of the plant. The number of leaves was more in the genotype Aca 49 (20.40) and it was found on par with the genotype Aca 15 (20.34) whereas lowest leaves (9.4) were recorded on Aca 38 (Natagarh local 03). The variation in number of branches per plant might have been due to own genetic makeup and also due to plant height. Boukary *et al.*, (2012) and Dwivedi *et al.*, (2012), observed the difference in production of leaves between varieties of onion and attributed this difference mainly to the cultivar, but other researchers confirmed that environmental conditions (Ijoyah *et al.*, 2008) in which plant growth contribute to the development of leaves on plant.

Table.1 Details of aggregatum onion Germplasm collected from Tamil Nadu and Gujarat

Code	Source	Code	Source
Aca 1	Coimbatore Local White	Aca 26	Sandhaipadugai Pink type-1
Aca 2	Oddanchatram	Aca 27	Sandhaipadugai White type- 2
Aca 3	Dindigul type -1	Aca 28	Gnanamedu White type- 1
Aca 4	Coimbatore Local Pink	Aca 29	Sandhaipadugai White type- 1
Aca 5	Dindigul type -2	Aca 30	Dhenkanal local 02
Aca 6	Rasipuram	Aca 31	Anugul local 09
Aca 7	Salem	Aca 32	Keonjhar local 07
Aca 8	Gnanamedu Pink type -1	Aca 33	Anugul local 06
Aca 9	Gnanamedu type - 1	Aca 34	Dhenkanal local 01
Aca 10	Gnanamedu type - 2	Aca 35	Balasore local 02
Aca 11	Gnanamedu type - 3	Aca 36	Keonjhar local 04
Aca 12	Sulur Pink type -1	Aca 37	Keonjhar local 06
Aca 13	Gnanamedu type - 4	Aca 38	Natagarh local 03
Aca 14	Mettukadai	Aca 39	Keonjhar local 05
Aca 15	Puttarsal	Aca 40	Ganjan local 01
Aca 16	Sandhaipadugai Pink type-3	Aca 41	Anugul local 08
Aca 17	CO (On) -5	Aca 42	Natagarh local 04
Aca 18	Sandhaipadugai Pink type- 2	Aca 43	Keonjhar local 01
Aca 19	Gnanamedu Pink type - 2	Aca 44	Keonjhar local 02
Aca 20	Sandhaipadugai Pink type- 4	Aca 45	Keonjhar local 03
Aca 21	Sandhaipadugai Pink type- 5	Aca 46	Mayurbhanji local 01
Aca 22	C.Mutlur	Aca 47	Khurda local 01
Aca 23	Sultanpet Pink	Aca 48	Khurda local 02
Aca 24	Thottapadi Pink	Aca 49	Nayagarh local 01
Aca 25	Gnanamedu Pink type - 3	Aca 50	Balasore local 01

Table.2 Performance of aggregatum onion genotypes for yield and quality traits

Accessions	Plant height (cm)	No. of leaves	Polar dia. (mm)	Equatorial dia. (mm)	Average clump weight (g)	Bulb colour	Total yield (t/ha)	TSS (%)	Thrips damage (%)	Leaf spot (PDI)
Aca 1	33.17	14.07	16.30	20.63	61.00	white	18.20	15.20	26.3	8.5
Aca 2	28.03	10.70	18.40	22.80	69.70	white	17.90	14.97	29.7	22.8
Aca 3	22.10	10.97	16.10	21.23	69.00	pink	15.80	14.93	30.1	15.7
Aca 4	24.20	9.43	25.57	29.63	80.30	pink	14.80	15.70	27.3	21.0
Aca 5	25.77	10.87	23.27	28.30	74.20	pink	13.77	15.10	10.8	11.1
Aca 6	36.00	17.17	16.63	21.70	65.60	pink	14.30	15.80	26.4	19.5
Aca 7	31.50	16.23	15.90	22.47	83.70	pink	17.67	16.03	17.1	14.8
Aca 8	36.17	14.20	22.30	27.10	79.50	pink	17.70	16.87	20.2	26.1
Aca 9	34.58	18.27	32.47	38.51	86.54	pink	21.04	17.05	18.5	13.7
Aca 10	29.80	9.83	26.50	26.10	68.60	pink	16.23	17.23	18.7	18.1
Aca 11	30.03	11.37	27.53	27.77	67.20	pink	17.90	14.83	21.7	11.5
Aca 12	38.70	12.27	35.93	34.57	71.50	pink	16.13	18.13	19.1	16.2
Aca 13	34.43	13.70	31.50	31.87	81.10	pink	15.47	16.20	13.1	14.8
Aca 14	36.93	14.40	32.13	27.87	82.10	pink	14.60	16.17	29.6	15.2
Aca 15	38.40	19.01	39.52	42.06	93.46	pink	23.18	18.69	9.1	9.8
Aca 16	36.63	14.27	30.80	33.67	77.60	pink	14.50	17.97	18.4	16.5
Aca 17	35.20	15.40	30.07	31.27	69.60	pink	16.23	15.87	19.5	16.3
Aca 18	27.30	13.43	26.37	27.77	66.00	pink	14.57	16.73	23.2	12.7
Aca 19	34.17	12.70	30.00	32.93	60.80	pink	15.23	16.97	27.6	21.9
Aca 20	29.17	10.20	25.53	28.33	77.20	pink	16.00	17.40	15.6	22.8
Aca 21	27.50	11.60	26.90	28.93	75.90	pink	16.43	16.43	27.6	11.8
Aca 22	28.23	11.87	28.93	27.47	74.90	pink	13.03	16.70	19.1	11.1
Aca 23	29.10	9.83	29.07	33.57	74.20	pink	12.63	18.87	10.9	12.1
Aca 24	30.33	16.17	31.10	35.70	86.20	pink	13.90	18.83	16.7	15.3
Aca 25	37.63	15.80	28.57	24.27	85.10	pink	15.70	19.47	26.7	16.3
Aca 26	27.37	13.77	33.10	32.80	83.20	pink	13.00	17.83	27.8	15.7
Aca 27	27.53	16.07	29.57	31.03	85.70	white	17.23	14.60	17.2	22.7
Aca 28	24.40	11.70	25.77	34.17	65.80	white	12.00	14.93	13.1	9.8
Aca 29	31.13	12.20	28.53	32.40	70.50	white	12.20	15.77	17.9	9.5
Aca 30	26.37	11.40	25.07	39.90	65.80	pink	12.43	17.73	26.4	14.8
Aca 31	34.00	12.57	29.37	35.60	71.10	pink	14.00	17.97	18.3	13.6
Aca 32	31.47	11.33	29.47	31.73	63.40	pink	10.53	16.93	26.7	19.7
Aca 33	37.10	11.57	31.77	34.93	66.20	pink	12.70	18.43	18.4	15.7

Aca 34	34.37	10.13	30.33	32.03	73.40	pink	12.57	18.87	17.0	15.9
Aca 35	38.30	9.60	33.30	35.70	80.30	pink	15.57	18.30	19.1	15.9
Aca 36	29.00	10.57	26.70	26.53	71.80	pink	12.07	15.10	27.6	17.6
Aca 37	34.10	17.47	30.73	27.30	65.80	pink	14.63	13.77	29.7	21.0
Aca 38	29.37	9.40	27.93	31.47	57.90	pink	9.30	16.20	13.9	19.5
Aca 39	28.00	9.50	24.97	23.60	55.50	pink	11.33	17.80	27.7	18.7
Aca 40	30.13	10.23	26.70	26.33	60.70	pink	11.80	19.77	27.6	21.9
Aca 41	31.07	20.23	28.33	29.70	75.50	pink	13.83	20.73	19.5	21.9
Aca 42	27.70	16.13	24.37	29.00	78.50	pink	14.60	21.00	21.2	19.7
Aca 43	29.17	17.67	25.23	25.33	78.10	pink	12.70	18.87	19.0	23.4
Aca 44	29.97	17.53	25.23	30.13	60.20	pink	12.73	20.13	25.8	26.2
Aca 45	25.07	17.13	23.70	34.33	72.80	pink	13.20	21.77	18.8	16.6
Aca 46	29.20	17.80	26.20	30.17	50.40	pink	9.57	22.07	16.1	13.2
Aca 47	30.63	19.03	14.97	31.07	53.10	pink	10.77	20.93	27.3	18.1
Aca 48	30.10	17.67	15.80	32.33	54.50	pink	11.50	18.50	19.9	16.2
Aca 49	34.13	20.40	13.67	30.33	86.00	pink	17.80	15.70	23.4	17.8
Aca 50	30.53	17.37	15.77	30.23	66.80	pink	16.20	14.53	17.2	15.1
S.Ed	0.67	0.76	1.04	0.73	1.60	-	0.48	0.34	0.97	1.21
CD (0.5)	1.34	1.49	2.05	1.43	3.10	-	0.95	0.66	1.91	2.48
CV	2.64	6.80	5.00	3.04	2.70	-	4.08	2.41	10.22	9.87

Fig.1 Evaluation of aggregatum onion genotypes – Field view

Fig.2 Promising genotypes based on yield, quality and resistance characters

Aca 15 (Puttarsal local type)

Aca 9 (Gnanamedu type - 1)

Polar diameter (thickness) in onion is an important character, because it indicates bulb storage ability. The onion with thin polar diameter, store better than skin diameter of bulbs. There was significance difference on polar diameter of bulb due to genotypic effect. The highest mean polar diameter (39.52 mm) was found on Puttarasal local and lowest (13.47 mm) was found on Nayagarh local 01. These results are in agreement with the results of the study conducted by Gautam *et al.,* (2006) and Azoom *et al.,* (2014). The lowest average equatorial diameter of 20.63 mm was recorded in Coimbatore Local White (Aca1) and highest equatorial diameter of 42.06 mm was found on Aca 15 (Puttarsal local). Furthermore, there was no toppling and sunken of neck in Aca 15. Thamburaj *et al.,* (1976) stated that increased bulb diameter gave higher yield in onion. Singh (1990) also indicated the importance of bulb diameter for higher bulb yield. Similarly, analogous data were founded for diameter of bulb by Moulin *et al.,* (2012) working on different varieties of melon, tomato, pepper and potato.

Yield is a complex trait influenced by many factors. In onion, the important yield contributing characters are mean weight of bulblets and bulb diameter. In the present experiments, significant variation in bulblet weight was noticed. The importance of bulblet weight as an important yield component has been reported by Padda *et al.,* (1973). Clump weight is the most important component that contributes directly to the yield in aggregatum onion. Among fifty genotypes, Aca 15 (Puttarsal) registered the highest average clump weight of 93.46 g and lowest clump weight (50.4 g) was recorded in Aca 46 (Mayurbhanji local 01). The highest clump weight in this genotype may be due to its genetic character and adaptability to agro-climatic conditions by the place of the experiment. Results of this study are in accordance with the findings of Boukary *et al.,* (2012); Moulin *et al.,* (2012). In onion bulb colour important character because it decide the consumer preference. Among the fifty genotypes evaluated five genotypes (Aca 1, Aca 2, Aca 27, Aca 28 and Aca 29) recorded white colour bulbs and remaining genotypes registered pink colour bulbs. The difference in the bulb of genotypes is due to their genetic nature. These results were in conformity with the findings of Rivera-Martinez *et al.,* 2005, Nilufar, 2009, Boukary *et al.,* 2012 and Azoom *et al.,* (2014). Yield is a composite character and is dependent on many constituent traits. Any change in these

constituent traits would reflect on total yield. Except Aca 15 (Puttarsal) and Aca 9 (Gnanamedu type - 1) all the genotypes recorded yield of less than 20 tonnes/ha and Aca 15 (23.18 t/ha) and Aca 9 (21.04 t/ha) recorded the highest total yield. The variation in yield might have been due to clump weight, diameter of bulbs, genetic nature and environmental factor.

The recorded variations of varieties in marketable yield could be due to their differences in genetic make-up (Pavlovic *et al.,* 2003) 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) 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, the parents, Aca 46 (22.07 °brix) and Aca 45 (21.77°brix) registered comparatively higher TSS content. The higher TSS value in these genotypes may be due to its inherent characteristics. Similar results were observed by Pavlovic *et al.,* 2003.

Resistance to pest and diseases

The major reasons for the low productivity of onion are the paucity of varieties adapted to different agro-climatic situations and growing conditions and the incidence of pests and diseases. Among the pests, onion thrips is important and it is not only a damaging pest but also act as a vector for viral diseases. Among the genotypes screened, Aca 15 (9.1%) recorded the lowest per cent of thrips damage, while Aca 3 (30.1%) recorded the highest per cent of thrips damage. Hence, use of tolerant varieties is the simplest and more convenient method of pest control.

Among the major constraints in the production of onion, leaf spot is very deleterious causing considerable damage to the crop both in yield and quality of the produce. Among genotypes, Aca 1 (8.5 per cent) recorded significantly low leaf spot damage followed by Aca 29 (9.5 per cent) and Aca 15 (9.8 per cent) compared to other lines. The disease is prevalent in almost all the major onion growing areas of India.

Based on the present results, it can be concluded that the onion varieties studied can be easily differentiated from one another due to their distinctive morphological characters and their performance under Coimbatore condition. The local varieties ‘Aca 15 (Puttarsal) and Aca 9 (Gnanamedu type - 1) performed best and recommended as a potential replacement to the low yielding variety under field conditions in Coimbatore region of Tamil Nadu (Fig. 2). This is associated with a higher number of leaves, diameter of bulbs, clump weight and yield and resistant to pest and disease respectively. 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 Tamil Nadu.

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