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# Correlation Studies for Bulb Yield and Yield Contributing Traits among Onion (*Allium cepa* L.) Genotypes

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***Authors' contributions***

*This work was carried out in collaboration between all authors. Author AAG performed the statistical analysis, contributed in writing the protocol and wrote the first draft of the manuscript. Author LA developed the protocol, supervised the work and reviewed the first draft. Authors BMS and AAA supervised the field work and contributed in reviewing the first draft of the work. All authors read and approved the final manuscript.*

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## ABSTRACT

Thirty-seven Onion (*Allium cepa* L.) genotypes comprising of twelve parents (12) and twenty-five hybrids were evaluated at the *Fadama* Teaching and Research farm of the Department of Crop Science, Usmanu Danfodiyo University, Sokoto during the 2015/2016 dry season. The objective of the study is to determine the correlation of characters among the 37 genotypes. The treatments were laid out in a Randomized Complete Block Design (RCBD) with three replications. After harvesting, the genotypes were stored for five months using farmers practice. The analysis of the results indicated highly significant (P<0.001) positive correlation between plant height and leaf area (1), plant height and leaf area index (0.84676), plant height and number of leaves (0.46727) plant height and percentage loss (0.43356) leaf area and leaf area index (0.85459), leaf area and cured bulb weight (0.47029), leaf area and percentage loss (0.50254) number of leaves and cured bulb weight (0.51363), number of leaves and percentage loss (0.43259), bulb diameter and bulb length

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(0.36367), bulb diameter and percentage loss (0.68209). Results obtained indicated highly significant (<0.001) negative correlation between leaf area index and days to maturity (-0.29333), leaf area index and number of leaves (- 0.29333), number of leaves and bulb diameter (- 0.02255), and between days to maturity and percentage loss (- 0.86679). Results obtained also revealed significant (<0.05) negative correlation between number of leaves and percentage bolting (- 0.26466) number of leaves and average bulb weight (- 0.26466) number of leaves and days to maturity (- 0.24959) days to maturity and average bulb weight (0.02255) cured bulb weight and days to maturity (-0.24001). The results of the study, therefore, conclude that Onion genotypes with longer maturity are best for storage.

*Keywords: Correlations; storage; maturity and Bulb.*

## 1. INTRODUCTION

Onion *(Allium cepa* L.) belongs to the family Alliaceae, other members include shallot *(A. cepa* L. var. *aggregation G.* Don.), common garlic *(A. sativum* L.), leek *(A. ampeloprasum* L. var. *porrum* L.) and chive *(A. schoenoprasum* L.) [1]. It originated from tropical central or western Asia and has been cultivated for a long period of time [2]. The cultivated onion is grown under a wide range of climates from temperate to tropical, it is the most important member of the family Alliaceae with monocotyledonous and cross-pollinating behaviour. It has diploid chromosome number 16 (2*n* = 16) [3]. Onion is a biennial vegetable crop, its economic yield is the bulb. Bulb formation is complicated and environmental factors such day length, temperature, moisture, soil type, fertilization, pests, and diseases affects its yield. Onion cultivars do not always perform in the same way year in year out and environmental factors strongly affect the development of onion cultivars [4]. The total world production of onions in 2013 was 4,281,501 tons, out of which 648,247 tons were obtained from Africa, 267,164 tons from West Africa and 235,000 tons from Nigeria. These tonnages were obtained from 230,180 ha, 46,469 ha, 16,221 ha and 14,000 ha respectively, with an average yield of 18,600.8 kg/ha globally, 13,950.1 kg/ha in West Africa, 16,470.3 kg/ha and 16,785.7 kg/ha for Nigeria [5]. Onion is valued for its distinct pungent flavour and its essential ingredients cuisine. It is consumed annually by all the sections of people through-out the world due to its healing properties in case of cardiac diseases, rheumatism, cancer, digestive disorders, blood sugar and prolong cough [6]. Onions are used both as foods and as seasoning; the immature bulbs are eaten raw or cooked and eaten as a vegetable [7]. Onion contains a phytochemical called Quercetin, which is effective in reducing cardiovascular diseases [8]. Correlation study is an important phase of breeding which was started in the last decades of $19^{th}$ century and the beginning of $20^{th}$century in order to simplify breeders work and for easy handling of material. Such investigations have to be carried out in various types of crop plants [9].

The objective of the study was to determine the correlation of characters among the 37 genotypes.

## 2. MATERIALS AND METHODS

The experiment was conducted at Fadama Teaching and Research farm of Usmanu Danfodiyo University, Sokoto (Lat 13º 06' 28" N and Long 05º 12' 46" E) during the 2015/2016 onion season (October 2015 – April 2016). The onion was however stored between the months of April and August. The climate is semiarid with a zone of savannah-type vegetation as part of the sub-Saharan Sudan belt of West Africa. It falls in Sudan Savanna agro-ecological zone. The rainfall starts mostly in June and ends in October with a mean annual rainfall of about 350 - 700 mm. The temperature of Sokoto ranges from 40 to 15°C [10].

The experiment consists of 12 parents (Table 1) and 25 hybrids (Table 2) making 37 Onion genotypes. Seeds of the genotypes were raised in the nursery where the soil was thoroughly mixed with farm yard manure at the rate of 5.5 t/ha. A sunken bed of 3.5m × 3m was constructed, divided into 37 segments and irrigated for two days. seeds of the genotypes were broadcasted in each segment and covered with millet stalk. The bed was irrigated daily and the stalks removed gradually after one week. The seedlings were then watered in the evening daily for ten days and then at three days interval. The seedlings were allowed to grow for seven weeks and then transplanted to the field. The vegetation

**Table 1. List of parents and their codes**

| S/N | Parent | Code | S/N | Code | Parent |
|---|---|---|---|---|---|
| 1 | KoriyaTounfafi Niger Republic | A | 7 | G | YarWurno |
| 2 | Yar Aka Aliero | B | 8 | H | Jar AlbasaIllela |
| 3 | Yaska | C | 9 | I | YarTungarTudu |
| 4 | Tasa | D | 10 | J | Jar AlbasaGwaranyo |
| 5 | Marsa | E | 11 | K | KibaGwaranyo |
| 6 | YarGigane | F | 12 | L | YarDawakin Kudu |

*S/N= Serial Number*

of the study experimental area was cleared, ploughed and harrowed. The physical and chemical properties of the site was also determined before planting (Table 3).

**Table 2. List of the twenty-five hybrids**

| S/N | Genotype | S/N | Genotype |
|---|---|---|---|
| 1 | A× C | 14 | D × H |
| 2 | A × F | 15 | D × J |
| 3 | A× L | 16 | E × F |
| 4 | B × E | 17 | E × H |
| 5 | B × K | 18 | E × I |
| 6 | C × E | 19 | E × K |
| 7 | C × F | 20 | F × J |
| 8 | C × G | 21 | F × L |
| 9 | C × H | 22 | G × K |
| 10 | C × I | 23 | G × L |
| 11 | C × J | 24 | H × L |
| 12 | C × K | 25 | K × L |
| 13 | D × G | | |

*S/N= Serial Number*

**Table 3. Physical and chemical properties of soil of the experimental site at kwalkwalawa village Sokoto**

| Parameters | 0 – 15 cm | 15 – 30 cm |
|---|---|---|
| **Particle size distribution** | | |
| Sand (g/kg) | 704 | 351 |
| Silt (g/kg) | 292 | 398 |
| Clay (g/kg) | 4 | 251 |
| pH | 4.5 | 5.4 |
| Organic carbon (g/kg) | 10.6 | 10.2 |
| Organic matter (g/kg) | 18.3 | 17.6 |
| Nitrogen (g/kg) | 0.84 | 0.42 |
| Phosphorous (g/kg) | 1.04 | 0.94 |
| Calcium (mol/kg) | 0.50 | 0.35 |
| Magnesium (mol/kg) | 0.20 | 0.15 |
| Potassium (mol/kg) | 1.03 | 0.97 |
| Sodium (mol/kg) | 1.00 | 0.87 |
| CEC (mol/kg) | 6.36 | 5.06 |

The seedlings were laid out in a randomized complete block design with one raw per treatment replicated three times. N.P.K 15:15:15 was applied at 30kg N/ha, 30kg $P_2O_5$/ha and 30 kg $K_2O$/ha as a basal application and subsequently top dressed with 30 kg N/ha using urea at 3 WAT. Seedlings were planted at a spacing of 15cm × 20cm. Irrigation was at two days after transplanting and thereafter at five days' interval. The first and second weeding were done at $4^{th}$ and $8^{th}$ week after transplanting (WAT). After harvesting the cured bulbs were stored for five months. Data was collected on plant height (cm), number of leaves per plant, leaf area ($cm^2$), leaf area index, bolting percentage (%), days to maturity, bulb diameter (cm), bulb height (cm), fresh bulb weight (t/ha), cured bulb weight (t/ha) and percentage loss. Data collected ware analyzed using Genstat $17^{th}$ edition.

## 3. RESULTS

Results obtained indicated highly significant ($P<0.001$) positive correlation between plant height and leaf area (1), plant height and leaf area index (0.84676), plant height and number of leaves (0.46727), plant height and percentage loss (0.43356) leaf area and leaf area index (0.85459), leaf area and cured bulb weight (0.47029), leaf area and percentage loss (0.50254), number of leaves per plant and cured bulb weight (0.51363), number of leaves and percentage loss (0.43259), bulb diameter and bulb length (0.36367), bulb diameter and percentage loss (0.68209), bulb diameter and leaf area index (0.39225), cured bulb weight and leaf area index (0.31277), percentage loss and leaf area index (0.43346), bulb length and bulb diameter (0.36367), percentage loss and bulb diameter (0.68209) and percentage loss and cured bulb weight (0.36614) (Table 4).

Significant (<0.05) positive correlation between plant height and bulb diameter (0.29647), plant height and cured bulb weight (0.31277), leaf area and bulb diameter (0.29647), bulb diameter and cured bulb weight (0.28133) (Table 4).

**Table 4. Correlation of characters among thirty seven parents and their hybrids at Sokoto during 2015/2016 season**

| | PH | LA | LAI | LN | PB | ABW | DTM | BD | BL | CBW | PL5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PH | 1 | | | | | | | | | | |
| LA | 1** | 1 | | | | | | | | | |
| LAI | 0.84676** | 0.84676** | 1 | | | | | | | | |
| LN | 0.46727** | 0.46727** | 0.85459** | 1 | | | | | | | |
| PB | -0.05762 | -0.05762 | -0.17977 | -0.26466* | 1 | | | | | | |
| ABW | -0.05762 | -0.05762 | -0.17977 | -0.26466* | | 1 | | | | | |
| DTM | -0.25061 | -0.25061 | -0.29333** | -0.24959* | 0.15016 | 0.15016 | 1 | | | | |
| BD | 0.29647* | 0.29647* | 0.39225** | 0.3541** | -0.13507 | -0.13507 | -0.53693** | 1 | | | |
| BL | 0.05346 | 0.05346 | 0.02251 | -0.02255 | 0.1233 | 0.1233 | -0.04175 | 0.36367** | 1 | | |
| CBW | 0.31277* | 0.31277** | 0.47029** | 0.51363** | -0.1247 | -0.1247 | -0.24001* | 0.28133* | -0.18945 | 1 | |
| PL5 | 0.43346** | 0.43346** | 0.50254** | 0.43259** | -0.21675 | -0.21675 | -0.86679** | 0.68209** | 0.11144 | 0.36614** | 1 |

*Key: PH= plant height, LA= leaf area, LAI= leaf area Index, LN = number of leaves per plant PB = percentage bolting, ABW=Average bulb weight, DTM = days to maturity, BD = bulb diameter, BL = Bulb length, CBW =Cured bulb weight and PL5 = percentage loss after five moth*

Results revealed highly significant (<0.001) negative correlation between leaf area index and days to maturity (-0.29333), leaf area index and number of leaves (- 0.29333), number of leaves and bulb diameter (- 0.02255), days to maturity and percentage loss (- 0.86679). Significant (<0.05) negative correlation was recorded between number of leaves and percentage bolting (- 0.26466), number of leaves and average bulb weight (- 0.26466), number of leaves per plant and days to maturity (- 0.24959), days to maturity and average bulb weight (0.02255), cured bulb weight and days to maturity (-0.24001) (Table 4).

## 4. DISCUSSION

Selection for cured bulb yield is expected to go along with leaf number, leaf area, leaf area index, plant height and average bulb weight. This therefore indicates that leaf number, leaf area, leaf area index, plant height and average bulb weight are important traits for selection of cured bulb yield. This result was in line with that of Abubakar et al. [11]] and Rahaman et al. [12]. The result also indicated that percentage loss after five months is positively correlated with plant height, leaf area, leaf area index, and leaf number per plant. This is an indication that plant height, leaf area, leaf area index, and leaf number should be avoided when selecting for storability. The result also revealed that leaf area index, days to maturity and cured bulb weight are negatively correlated with percentage loss, therefore the more the delay in maturity, the less the percentage loss and therefore the better the storability.

## 5. CONCLUSION

The result of the study, therefore, indicated that genotypes with high storability, early maturity, and high yield potentials can be selected for among the evaluated genotypes.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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