P-ISSN: 2305-6622; E-ISSN: 2306-3599

International Journal of Agriculture and Biosciences

www.ijagbio.com; editor@ijagbio.com

Research Article

Pearson Correlation Analysis of Marketable Bulb Yield with Growth, Yield Components and Storage Parameters of onion

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Article History: Received: March 23, 2019 Revised: October 27, 2019 Accepted: November 15, 2019

ABSTRACT

The experiment was conducted under furrow irrigation at Shire-Maistebri Agricultural Research Center (SMARC) Selekeleka research site, in north western Tigray, northern Ethiopia during 2015/2016 (October – June) to study the relationship among growth, yield components and storage parameter of onion *(Allium cepa L.)*.The Correlation coefficient analysis revealed that marketable bulb yield was highly significant and positively correlated with plant height, leaf number, leaf length, bulb length, bulb diameter, mean bulb weight, biological yield, total dry biomass and harvest index. In addition to this, yield was significant association with bulb rotting and sprouting while negatively and statistically in-significant to bulb weight loss.

Key words: Correlation, Onion marketable yield, Growth parameters

INTRODUCTION

Onion (*Allium cepa* L.) a member of Amaryllidaceae family is one of the most important mono-cotyledonous condiment crop. This most widely used condiment, believed to be originated in Central Asia, possesses tremendous popularity as well as economic importance all over the world. About 170 countries of the world cultivate onions for domestic use while some also grow onions for trade. About 9.2 million acres of onions are harvested each year on a global scale and 8% of this harvest is internationally traded. China, India, and the US are the world's leading onion producing countries (FAO, 2014).

Onions are grown in all tropical areas and play a key role in the economy of many developing countries. In terms of gross value production, onions are the world's 2nd most important crop after tomato (Brewster, 2002). As a staple crop, onions, including shallot, garlic and leek, contribute the food security of millions of people in most of developing world and when traded in local markets, they provide income and employment to rural population (Boyhan *et al.*, 2001).

Onions are key contributors to the economies of many low-income countries like Ethiopia (CACC, 2002). It is considered as one of the most important vegetable produced on small scale in Ethiopia. It occupies an economically important place among vegetables in the country. The area under onion is increasing from time to time mainly due to its high profitability per unite area and expansion of irrigation infrastructure in different parts of the country (Olani N, Fikre M., 2010). The crop is produced both under rain fed and under irrigation in the off season. In many areas of the country, the off-season crop (under irrigation) constitutes much of the area under onion production (CACC, 2002).

Onion is one of the most important vegetable crops cultivated mostly under irrigated conditions in North Western Zone of Tigray Region particularly in Selekeleka district. During 2014-15 cropping season the irrigable area in the district were covered by onion, shallot, garlic, tomato and pepper, 1154.75, 165, 634, 2265.75 and 945 ha respectively according to district office of Agriculture Annual Onion Technical Report, 2013 (Unpublished). According to Shire-Maitsebri Agricultural Research Center SMARC Problem Appraisal, 2013 (Unpublished) Continuous use of inorganic fertilizers and inappropriate soil fertility management practices are among the major factors limiting onion productivity in Selekeleka district. A study conducted by (Gebremichael *et al*., 2017) reported that the highest marketable yield with better shelf life of onion was obtained from the application of 5 t ha^{-1} of vermicompost + 50% nitrogen, but the correlation among the yield with growth and other yield attributes was not studied. Therefore, the objective of this study is to determine the relationship between all growth, yield components and shelf life of onion.

Cite This Article as: Gebremichael Y, 2019. Correlation analysis of marketable bulb yield with growth, yield components and storage parameters of onion. Inter J Agri Biosci, 8(6): 321-324. www.ijagbio.com

MATERIALS AND METHODS

Description of the study area

The experiment was conducted at Shire-Maistebri Agricultural Research Center (SMARC) Selekeleka research site, in north western Tigray, northern Ethiopia during 2015-2016 (October – June). Selekeleka is located 1065 km north of Addis Ababa at 14°6′43″ N, 38°27′50″E, and at an altitude of 1951 m above sea level. The mean annual rainfall is 680 mm. The soil textural class is clay loam with pH of 7.2. The organic matter, total nitrogen, available phosphorus, organic carbon, CEC, EC, exchangeable potassium and available potassium content were 1.910 %, 0.1736 %, 23.7 ppm, 1.108 %, 46.2 meq/100 gram of soil, 0.17 ms/cm, 173 ppm and 134 ppm, respectively. The rainy season extends from June to September and the maximum rain is received in the months of June to August (Mekelle Meteorological Station, 2016). The rural area around the study site is known for the mixed crop-livestock farming system in which cultivation of Teff, Sorghum, Maize, Finger Millet and pulse crops are the major cropping activities (Yayneshet, 2010).

Treatments and experimental design

The treatments consist of combinations of two rates of FYM (10 and 20 t ha^{-1}) and two rates of vermicompost (2.5 and 5 t ha^{-1}) each combined with three recommended rates (25, 50 and 75%) of inorganic N fertilizers. In addition, 100% recommended rate of inorganic N fertilizer (69 kg N), 100% (5 t ha^{-1}) of VC, 100% (20 t ha^{-1}) FYM and zero rates (unfertilized treatment) were used for comparison. The experiment was laid out in a randomized complete block design (RCBD) with three replications. The gross plot size was 2 m x 3 m (6 m^2). The distance between blocks were 1.5 meters whereas the distance between plots were 1m and the spacing between rows and plants were 40cm (with double rows at 20 cm) and 10cm, respectively.

Data collection

Yield traits were recorded following the standard procedures used for onion by taking the average value of nine representative plants per plot. Storage parameters such as sprouting, rotting, and total weight loss were also taken.

Data analysis

The data of different yield related traits collected from field measurement were organized and analyzed using SAS statistical package (SAS, 2002).

RESULTS AND DISCUSSION

Correlation of plant growth and marketable bulb yield

Knowledge of interaction among the characters is very essential in plant breeding to determine the extent and nature of relationship between yields, yield related traits and physiological characters. Correlation is simply a measurement of mutual association without regards to causation.

Correlation coefficient was calculated for the different response variables which help to show how the yield components and growth characters were affecting the marketable yield of onion. Thus, it was observed that marketable bulb yield was highly significantly and positively correlated ($p<0.001$) with plant height (r=0.76***), leaf number (r=0.66***), leaf length (r=0.80***), bulb length (r=0.81***), bulb diameter (r=0.84***), mean bulb weight (r=0.87***), biological yield (r=0.88***), total dry biomass (r=0.73), and harvest index (r=0.76***) (Table 1). Similarly (Abayneh, 2001) reported, marketable yield per plant showed positive and significant phenotypic association with plant height, leaf length, leaf diameter, neck thickness, above ground fresh and dry weight, harvest index and biological yield per plant. Similar result was also reported by (Gurjar and Singhania, 2006) who reported significantly and positive correlation for bulb yield to plant height, number of leaves per plant, equatorial and polar bulb diameter. The increase in plant height, number of leaves and other positively correlated characters increased the amount of assimilates being produced and translocated to the sink which finally has bearing on the yield. The positive and significant correlation r values between marketable yield and growth parameters of onion indicate that marketable yield is highly influenced by these growth parameters. This indicated the trend that improvement of these characters could improve physiological capacity to mobilize and translocate photosynthates to the organs of economic value, which in turn might have increased the bulb yield resulting from positive association of these characters with yield as observed in the present study. Similar result was reported by Fehr (1987).

Patil (1997) observed that equatorial and polar bulb diameter showed positive significant correlation with bulb yield. Hence, application of vermicompost and inorganic nitrogen fertilizers which directly influences onion growth parameter improves on onion marketable yield. This association indicates that an increased photosynthetic area in response to vermicompost and inorganic nitrogen fertilizers had substantially contributed to enhanced onion productivity that could be through the production of more assimilates. On the other hand, days to maturity and bulb dry weight did not correlate significantly ($p>0.05$) with onion marketable yield.

In the present study, mean bulb weight was strongly correlated and highly significant ($p<0.001$) with plant height (r=0.87***), leaf number (r=0.80***), leaf length (r=0.86***), bulb length (r=0.90***), bulb diameter (r=0.88***), biological yield (r=0.99***), total dry biomass (r=0.85***), harvesting index (r=0.84***), marketable yield (r=0.87***) and total yield (r=0.87***). Netrapal *et al.*1988, Mohanty(2001), and Mahanthesh *et al.*2007, they reported that there is positive association between number of leaves and bulb yield. Mean bulb weight improvement in response to vermicompost and inorganic nitrogen could be attributed to the increase in plant height, number of leaves produced, leaf length, and extended physiological maturity in response to the fertilization all might have increased assimilate production and allocation to the bulbs. Similar result was reported by Rice *et al.*, (1993) who reported that onion bulb size can be increased by application of N during the growing period. Hosamani *et al.* (2010) reported the positive correlation of bulb diameter and average bulb weight with bulb yield.

Table 1: Simple correlation between yield, yield components and growth characters

Variables	DM	PH	LN	LL	NT	BL	BD	MBW
DM	1							
PH	-0.109 ns	1						
LN	-0.121ns	0.916 ***	1					
LL	0.004ns	0.945***	0.902***	1				
NT	-0.487 ***	0.019ns	-0.124ns	-0.04 ns	1			
BL	0.056 ns	0.930***	0.890***	0.944***	-0.073 ns	1		
BD	0.146 ns	0.853***	0.779***	0.873***	-0.022ns	0.920***	1	
MBW	0.139 ns	0.867***	0.800 ***	0.856***	-0.0715ns	0.896***	0.875***	1

Key: ns=indicates non-significant difference at 5%, ***= significant difference at 0.1%. DM, PH, LN, LL, NT, BL, BD, and MBW, days to maturity, plant height, leaf number, leaf length, neck thickness, bulb length, bulb diameter, and mean bulb weight respectively.

Table 2: Simple correlations

Variables	BIOY	BDW	TDB	HI	MY	UMY	TY
BIOY	1						
BDW	0.227ns	1					
TDB	0.882***	0.637***	1				
HI	0.864***	0.586***	0.935***	1			
MY	0.876***	0.134ns	0.729***	0.762***	1		
UMY	-0.787***	0.004ns	-0.585***	-0.660***	-0.839***	1	
TY	0.871***	0.143ns	0.730***	0.760***	0.999***	-0.815***	1

Key: ns=indicates non-significant difference at 5%, ***= significant difference at 0.1%. BIOY, BDW, TDB, HI, MY, UMY, and TY, biological yield, bulb dry weight and total dry biomass, harvest index, marketable yield, unmarketable yield and total yield respectively.

Table 2: Correlation coefficient of yield component and bulb storage parameters

Variables	BWL	BR	BST	NT	BD	BL	MBW	MY
BWL	1							
BR	0.14ns	1						
SP	0.09ns	0.90***	1					
NT	-0.59*	0.47ns	0.40ns	1				
BD	-0.36ns	0.52*	0.44ns	0.86***	1			
BL	-0.46ns	0.44ns	0.36ns	0.91***	0.97***	1		
MBW	-0.53*	0.53*	0.42ns	0.90***	0.94***	0.91***	1	
MY	-0.45ns	0.61*	0.51*	0.94***	0.94***	0.90***	0.96***	1

Key: ns=indicates non-significant difference at 5%, *=significant difference at 5%, ***= significant difference at 0.1%. BWL, BR, BST, NT, BD, BL, MBW, and MY, bulb weight loss, bulb rotting, bulb sprouting, neck thickness, bulb diameter, bulb length, mean bulb weight, and marketable yield.

Correlation of yield component and storage parameter

Neck thickness was correlated statistically non-significant with bulb rotting (r=0.47ns), bulb sprouting (r=0.40ns) and statistically negative correlated to bulb weight loss (r= -0.59*) (Table 2). As neck thickness was increased, bulb rotting and sprouting was also increased but statistically in-significant while bulb while bulb weight loss decreased. Bulb diameter significantly correlated with bulb rotting (r=0.52*), but statistically non-significant with bulb sprouting (r=0.44ns) and negatively correlated non-significant with bulb weight loss (r= -0.36ns).Similar result was reported by (ZEWDE, 2006) who reported that bulb weight loss and bulb diameter losses are among the physical parameters that have a direct relation with size and marketability of bulbs. On the other hand bulb length were correlated non-significantly with bulb rotting (r=0.44ns), sprouting (r=0.36ns) and negatively weight loss (r= -0.46ns). Mean bulb weight had significant association with bulb rotting (r=0.53*) and negatively to weight loss (r= -0.53*), but statistically non-significant association with bulb sprouting (r=0.42ns). Marketable yield also had significant association with bulb rotting (r=0.61*) and sprouting (r=0.51*) while negatively statistically in significant to bulb weight loss (r= -0.45).Which implies that as marketable yield increased bulb rotting and sprouting increased while bulb weight loss decreased in significantly.

Conclusions

The Correlation coefficient values displayed positive and significant correlation (r values between marketable yield and growth parameters. onion marketable yield is highly influenced by these growth parameters. Correlation of yield component and storage parameter also showed that as bulb neck thickness increased bulb rotting and sprouting increase but statistically in significant while bulb weight loss decreased. Bulb diameter significantly correlated with bulb rotting, but statistically non-significant with bulb sprouting and bulb weight loss. Mean bulb weight had significant association with bulb rotting and negatively to weight loss, but statistically non-significant association with bulb sprouting. Marketable yield also had significant association with bulb rotting and sprouting while negatively and statistically in-significant to bulb weight loss. Based on this result, we suggest that the increased individual growth parameters are fundamental to maximize onion productivity per unit area.

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