Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online) DOI: 10.7176/JBAH
Vol.9, No.17, 2019

Review of the Intra Row Spacing Effect on the Yield & Yield Component of Onion (Allium cepa L.)

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Abstract
Onion is an important vegetable crop, which has produced worldwide including our country for its daily uses as food, house hold income generation and medicinal plants. Although it is very important and have high requirement in Ethiopia, the productivity of this crop is less than the world's average because of many things. The main reason for this lower productivity of the crop is most probably lack of inappropriate agronomic practices, luck of high yielding varieties and little given attention to the crop. From the agronomic practices, plant population depending on soil condition, variety and environmental condition is the main one. Hence, most of the grower uses cultural knowledge of agronomic practices which are inferior in production and productivity. Therefore, this paper mainly focuses on the previous work done on the agronomic improvement (plant population) practices in the country and its future progress.
Keywords: Agronomic practices, Production, Plant population
DOI: 10.7176/JBAH/9-17-06
Publication date:September 30th 2019

Introduction

Onion (*Allium cepa*) belongs to the genus *Allium* of the family *Alleacea,* which is originated in southwest Asia and the Mediterranean regions. This crop is one of the oldest cultivated vegetables which traced back to at least 5000 years and has been in cultivation for more than 4000 years (Gessesew *et al*. 2015).

This crop is a biennial and/or annual crop. It is grown as annuals for bulb, but it takes two seasons for seed production. In Ethiopia onion is widely grown in the rift valley and lakes region of the country (Desalegn and Aklilu 2003). It is considered as one of the most important vegetable crops produced on large scale in Ethiopia (Olani and Fikre 2010). It also occupies economically important place among vegetables in the country (Gessesew *et al*. 2015).

In Ethiopia, its production history is stretched back to 1970's when foreigners brought the planting material into the country from Sudan and since its intensive production has been started. Later on, the improved cultivars were released by Melkasa agricultural research center which has been incorporated into the farming system of the country (Habtamu 2017). The optimum use of spacing or plant population has dual advantage. It also avoids strong competition between plants for growth factor such as water, nutrient, and light (Awas *et al.* 2010).

Lack of improved varieties, improper agronomic practice (spacing and other management) used by farmers and absence of technologies are the major bottleneck of onion production and productivity (Belay *et al*. 2015). The institutional environment is also affects the decision of farmers to adopt onion production package. This is due to poor road network, unavailability of reliable source of price information, the prices settled by middle man and the traders (Bikila 2012). Therefore, the main objective of this review paper mainly focuses on the work done about the matter of population (intra-row spacing) on the yield and yield component of onion.

Intra row spacing effects on the Onion yield component

Identification of this yield-limiting factor due to population density is very important for onion yield improvement progress which is able to contribute against to lower yield trends in our country (Habtamu 2017). In appropriate use of plant spacing and lack of evaluation of improved varieties across agro ecologies are the predominant agronomic practices that reduce the productivity of onion (Demisie and Tolessa 2018).

Plant height

According to Demisie and Tolessa (2018), the intra-row spacing has significant effect on the plant height and as spacing increased from 7 to 13 cm, the plant height also increased from 58.79 cm to 64 cm long. Good growth performance of onion can be obtained from 15 cm intra row spacing (Gessesew *et al*. 2015 and Belay *et al.* 2015). But, different findings have shown as the productivity of the crop. As observation of Tekle (2015): increasing the intra row spacing from 2.5 to 7.5 cm increased plant height significantly and increase in plant spacing further from 7.5 cm to 12.5 cm did not show significant difference.

Gebretsadik idea is a controversial to all of the above and he says that across the widening of intra-row spacing from 4 to 10 cm, there was no consistent increase or decrease in plant height (Gebretsadik 2016). This shows that depending on the cultivar, environmental conditions and fertility of the soil the spacing may have different value on the onion plant height.

Leaf number per plant

The research done in Haramaya University states that, increasing plant spacing significantly increases onion leaf number per plant and the highest leaf number is produced from 12.5cm intra row spacing (Tekle 2015; Gebretsadik 2016; Gebretsadik and Dechassa 2018). Since the increasing plant leaf number is for all of their idea, different researcher have different intra row spacing recommendation.

But, the research done in Addis Ababa University College of Veterinary Medicine & Agriculture by Belay *et al.* (2015) states, leaf number was not significantly affected by intra row spacing. This may be due to environmental condition and soil fertility.

Leaf length

Intra row spacing of 10cm produced the longest leaf length (28.5cm) and the shortest (23.7cm) was recorded at the narrow (5cm) intra row spacing. This is probably, attributed to increased competition for nutrients and moisture at higher plant density (Belay *et al.* 2015 and Tekle 2015). But, the experiment conducted by Gebretsadik and Dechassa (2018) in Tigray region at Tahtay Koraro district was display as leaf length was not significantly influenced by intra row spacing.

Leaf diameter

Recent research done at Jimma University College of Agriculture and Veterinary Medicine have recorded that, a significant difference among the intra row spacing for leaf diameter. Accordingly, the wider intra row spacing, the wider leaf diameter was produced (Demisie and Tolessa 2018 and Tekle 2015). Since different researcher have different conclusions, the increasing intra row spacing of onion have the widening leaf diameter up to 12.5cm spacing.

Dry total biomass yield

With the increases in intra row spacing, dry total biomass yield of the onion plants also increases (Belay *et al.* 2015; Tekle 2015) (Figure 2). It is recorded that: intra-row spacing increased from 5 to 10cm, average dry biomass yield was also increased from 36.93g to 42g (Tekle 2015). The research done at Farmers' Training Centre of Shire district Tigray Region demonstrates that plants grown at the widest spacing produced the highest dry total biomass yield possibly due to less stiff competition among them for growth factors (Gebretsadik and Dechassa 2016).

Average bulb weight

The result gained from research done at Jimma University College of Agriculture and Veterinary Medicine shows that effect of intra row spacing was highly significantly influence bulb dry weight and the highest and the lowest average bulb weight were recorded at a wider intra-row spacing of 13 and 7cm spacing respectively (Belay *et al.* 2015 and Demisie and Tolessa 2018) (Figure 2). Data analyzed by Gebretsadik and Dechassa (2016) from research done at Farmers' Training Centre of Shire district Tigray Region shows that further widening of the intra row spacing above 6cm did not change bulb fresh weight.

Bulb diameter

Because of the gaining of high space, with the increase in intra row spacing, average bulb diameter of the onion plants increased. The data recorded from Axum Agricultural Research Center shows that, the plant spaced at 12.5 cm intra row spacing produced the highest bulb diameter (Tekle 2015; Gebretsadik and Dechassa 2016).

Bulb dry matter yield

The effect of intra row spacing was significantly influence bulb dry weight and as intra-row spacing increased from 5cm to 10cm, the bulb dry weight was also increased from 10.3g to 28.13g (Belay *et al.* 2015 and Tekle 2015). Since the result gained recommended at different spacing most researchers concluded that, the intra row spacing of 10-12.5cm produce the highest yield (Figure 2).

Total bulb yield

Increasing the intra row spacing from 4 to 6 cm significantly increases the total bulb yield. However, increasing higher spacing did not change total bulb yield and this result shows that plants grown at intra row spacing of 6 cm produces the highest mean total bulb yields (Gebretsadik and Dechassa 2016; Gebretsadik 2016). But, the data recorded from Axum Agricultural Research Center by Tekle (2015) shows increasing intra row spacing more than 5cm decreases the total bulb yield of onion. Kahsay *et al.* (2013) also agree with the idea of Tekle (2015) (Figure 1).

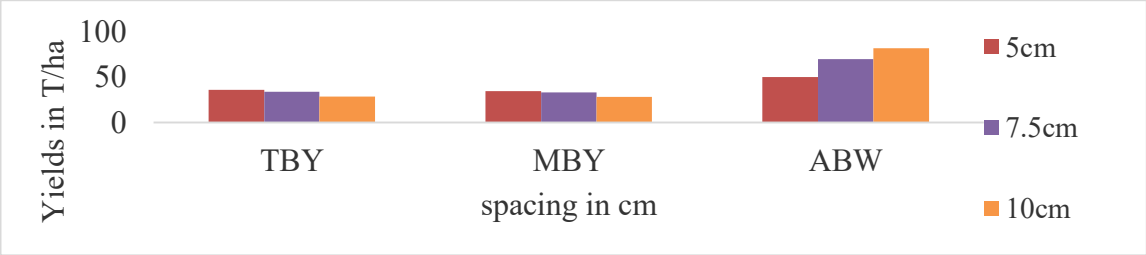

Figure 1 Effect of intra row spacing and variety on total bulb yield (TBY), marketable bulb yield (MBY) and average bulb weight (ABW) of onion. Source: Kahsay *et al.* (2013)

Marketable bulb yield

According to figure 1 above intra row spacing had a significant effect on marketable bulb yield and the highest marketable bulb yield (34t/ha) was obtained from plants grown at 5cm intra row spacing while that of 10cm showed the lowest marketable bulb yield (27t/ha) (Kahsay *et al.* 2013; Tekle 2015). Accordingly, as an intra row spacing level increases the marketable bulb yield decreases (Kahsay *et al.* 2013; Tekle 2015; Gebretsadik and Dechassa 2018; Demisie and Tolessa 2018).

Unmarketable bulb yield

With the increase in the intra row spacing unmarketable bulb yield of onion decreased significantly (Kahsay *et al.* 2013; Tekle 2015; Gebretsadik and Dechassa 2016 and 2018). The highest yield is produced at 2.5cm intra row spacing (Tekle 2015). Even though almost all researches concluded as the narrowest spacing to produce highest unmarketable yield their conclusion on the spacing type are different.

Total bulb weight

As shown on the (figure 1) with the increase in intra row spacing, average bulb weight of the onion plants increased (Kahsay *et al.* 2013; Tekle 2015; Belay *et al.* 2015; Tegen *et al*. 2016; Demisie and Tolessa 2018). The data recorded from Axum Agricultural Research Center shows that: plant spaced at 12.5 cm intra row spacing produces the highest average bulb weight (Tekle 2015).

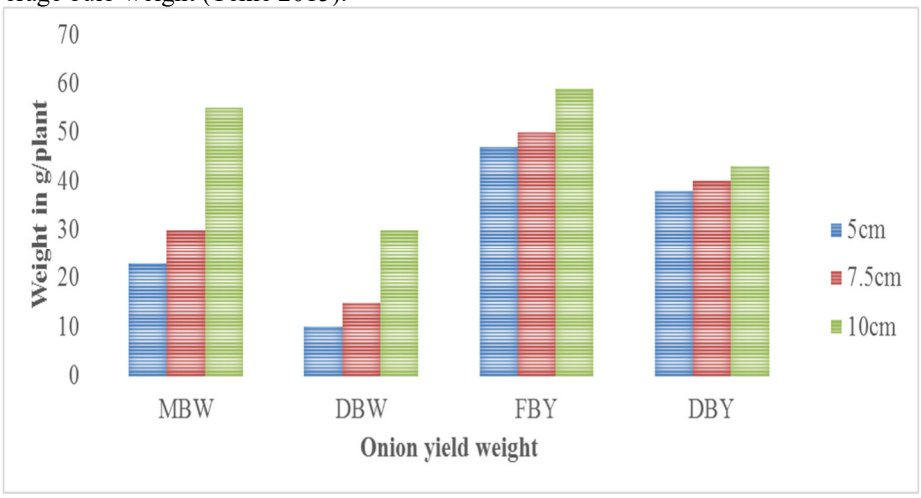

Fig. 1: The effect of plant spacing on mean bulb weight (g/plant), dry bulb weight (g/plant), fresh biomass yield (g/plant) and dry biomass yield (g/plant) of Adama red onion evaluated at Fiche

MBW= Mean Bulb Weight, DBW=Dry Bulb Weight, FBY =Fresh Biomass Yield, DBY= Dry Biomass (Belay *et al*. 2015).

Summary and conclusions

To get the better yield the better agronomic practices, environmental condition and genetic variety is a must. From that an agronomic practices especially at the farmer level, this things have to be thinking care over it and the intra row spacing is one part of the agronomic practices. The control of plant spacing is vulnerable way of controlling bulb size, shape and yield. Most results of the present study indicated that growth parameters and yield components increased as intra-row spacing extended up to13cm. But, widening above 13cm it is only extravagance of land and has no value on the yield. For the onion dry total biomass yield, bulb weight and bulb size 10cm intra row spacing may be enough. Widening the intra row spacing tended to decrease the yield of unmarketable bulbs of the crop and increase the yield of marketable bulb yield.

In general, the increase in spacing changes the yield of onion and the recommendation may depends on genetic variety, environmental condition, soil fertility and humidity. To the future, it is preferred if the research

have done with interaction of fertilizer or variety or both of them to check whether the spacing problem is soil caused by fertility, variety difference, soil humidity or spacing. There is also a gap of giving practical training for the farmer and also doing around farmers' training center for improving the gap of agronomic knowledge of most of our farmers.

Conflicts of interests

There is no conflicts of interests at all.

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