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Effect of sowing method and weed pressure on growth and quality of onion (*Allium Cepa)* seedlings

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Abstract

Onion is an important vegetable cultivated for its culinary and medicinal value. It is slow growing with cylindrical and erect leaves. This makes it a poor competitor against weeds as the crop cover cannot smother out weeds. An experiment was carried out to determine the influence of sowing methods and duration of weed pressure on the growth and quality of onion (*Allium cepa*) seedlings. The experiment was laid out as a split plot design in a randomized complete block arrangement with three replicates. The main plot was two sowing methods (broadcast and line) and the subplot was duration of weed pressure (weed free, weeding at 2 weeks, weeding at 3 weeks, weeding at 4 weeks, weeding at 5 weeks and weeding at 6 weeks).Data were recorded on weed density per m^2, weed dry weight and seedling growth parameters (height, diameter, weight and density). Sowing method had a significant ($P<0.01$) effect on weed density and the broadcasting method maintained a higher weed density throughout the growing period. Weed pressure significantly ($p<0.01$) reduced onion seedling growth parameters. Early weed management is recommended as it improves growth and quality of onion seedlings.

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Introduction

Onion (*Allium cepa* L.) belongs to the Alliaceae or Lily Family. There are about 500 widely scattered species in the genus *Allium* and many of them have the characteristic onion flavour and odour (Fenwick and Hanley, 1985).It is believed to have originated in North West India, Baluchistan and Afghanistan (Mehta, 2017). Its first domestication is believed to be the mountainous regions of North Iran, Afghanistan and Pakistan (Tindall, 1983).Onion is widely adapted to different climatic regions in the world and is a major vegetable crop in many tropical countries being cultivated mainly for its culinary and medicinal value (Mehta, 2017). It is ranked as the second most economically important vegetable with an estimated global annual production of 75 million tonnes recorded in 2017 (APEDA, 2017).However, its production is constrained by lack of water for irrigation, diseases, seed availability and weed management among other factors (Berhanu and Berhanu, 2014; Made *et al.,* 1994).

Weeds compete for resources such as light, nutrients, moisture and space (Uygur *et al.,* 2010). The growth rate of onion is slow following germination and their erect cylindrical leaves produce little canopy that could smother weeds (Wicks *et al.,* 1973). This poor competitive ability coupled with its initial slow growth and lack of adequate foliage make onion a weak competitor against weeds(Uygur *et al.,* 2010) and yield losses of between 40% and 80% have been recorded depending on the duration of weed competition and intensity of the weed pressure (Channapa goudar and Biradar, 2007). An integrated weed management approach was been found to be effective in reducing weed pressure in bulb crops. In Zimbabwe, hoeing and hand pulling are the most commonly used methods of weed control particularly in smallholder resource-poor farmers who may not afford herbicides (Mandumbu *et al.,* 2011). However, these methods are laborious, time consuming and expensive due to the closer spacing of onion (Sahoo *et al.,* 2017).

Onions are predominantly produced from seeds and transplanting is widely used despite the development and improvement of direct sowing method in both temperate and tropical regions (Huda, 1997). The production of a good quality seedling that can withstand transplanting shock is critical to ensure a good plant stand. The advent of seedling production in multi-cellular trays has improved production of vegetable seedling as individual plants are held in individual cells with reduced competition (Costa *et al.*, 2013). However, seedbed production is still relevant and practiced world over in raising onion seedlings. Broadcasting the seeds and line sowing are the sowing methods that are used in raising seedlings nursery (Hoque and Wohab, 2013). In most cases, farmers prefer line sowing as it is easier to manage in terms of weed control and other management practices (Evers and Bastiaans, 2016).

The critical weed competition period for many crops is the period after crop emergence or at planting at which weeds must be removed for non-significant yield loss. However, this period depends on the competing crop, weeds species, their densities as well as agricultural operations (Qasem, 2005). Some farmers fail to control weeds in their crops because of many activities that occur at the same time, thus fields are neglected for long periods before weeding can be done. This subjects the crop to longer periods of weed pressure. Therefore, this research was conducted to determine the effects of weed pressure and sowing methods on growth and quality of onion seedlings.

Materials and methods

Study site

The experiment was conducted at Green croft nursery in Harare, Zimbabwe. The area receives mean annual rainfall between 800 and1000mm and experiences mean temperature ranges of 10 to 26^{o}C. Harare is in the Highveld with an altitude of 1506metres above sea level. It is located at Latitude of 1750^{o}S and Longitude of 310^{o} E. The site has red alluvial clay soils.

Experimental design and treatments

The experiment was laid out as a split plot design with three replicates and six treatments. The main plots were sowing methods; broadcasting and line sowing. The subplots were period of weed pressure with the following treatment levels; weed free, two weeks, three weeks, four weeks, five weeks and six weed pressure. The main plot size was 4,2m by 1m and sub plots were 0.7m by 1m long.

Trial Management

Beds measuring 4,2m by 1m were prepared to a fine tilth and Compound D,NPK (7:14:7) fertilizer was applied and incorporated into the soil before sowing. Onion variety Texas Grano was used in this study. Seeds were sown according to the method of sowing for each treatment and were covered with sand to facilitate ease of emergence.

The beds were irrigated soon after sowing and irrigation was maintained daily until seedling emergence. The control treatment was maintained weed-free throughout the duration of the experiment by hand pulling the weeds.

Data collection

Weed density was recorded at 14 days after emergence and thereafter weekly until six weeks after emergence. Weed density was carried out by randomly placing a 0.5mx0.5mquadrat per plot and counting all the weeds within the quadrat. Weed biomass was assessed by removing all the weeds within the quadrat and fresh weight was recorded. The weeds were then oven dried at 80°C for 36 hours. Stem diameter and plant height were recorded at transplanting using a veneer calipers to assess the growth and quality of the seedlings.

Data analysis

Data were subjected to Analysis of variance using Genstat version 14 software. Means were separated using the least significant difference at 5% level of significance.

Results and discussion

Seedling height

Weed competition significantly affected ($P<0.01$) height of onion seedlings. The highest plant height was observed on the weed free treatment followed by week two and lowest plant height was obtained from week six (Fig. 1).

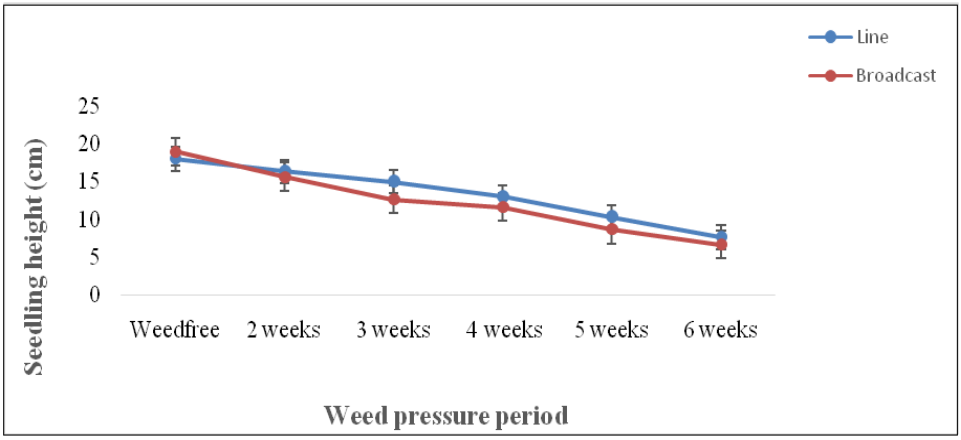

Fig. 1. Effect of weed pressure on height of onion seedlings. Vertical bars represent standard error bars of means.

Height of seedlings decreased as the duration of weed pressure increased. The onion plant is a poor weed competitor during the early stages of growth owing to its slow growth rate, small cylindrical, erect leaves and hence it fails to smoother out weeds (Chopra and Chopra, 2006). Continuous weed pressure had the

lowest seedling height and this could be due to reduced number of functional leaves, their size and chlorophyll content which lead to reduced photosynthesis and reduced growth (Gaffor *et al.,* 2000; Hewson and Roberts, 1972).

Seedling diameter

Weed pressure had significant effect ($p<0.01$) on stem diameter. The weed free treatment had the biggest stem diameter and the greatest reduction in stem diameter was obtained when the weeds were allowed to compete for the entire growing period. A bigger seedling diameter (3.60mm) was observed in the line method than broadcasting method(3.03) but this was only observed in the weed free treatment and thereafter, no significant differences ($p>0.05$) were observed between sowing methods (Fig. 2).

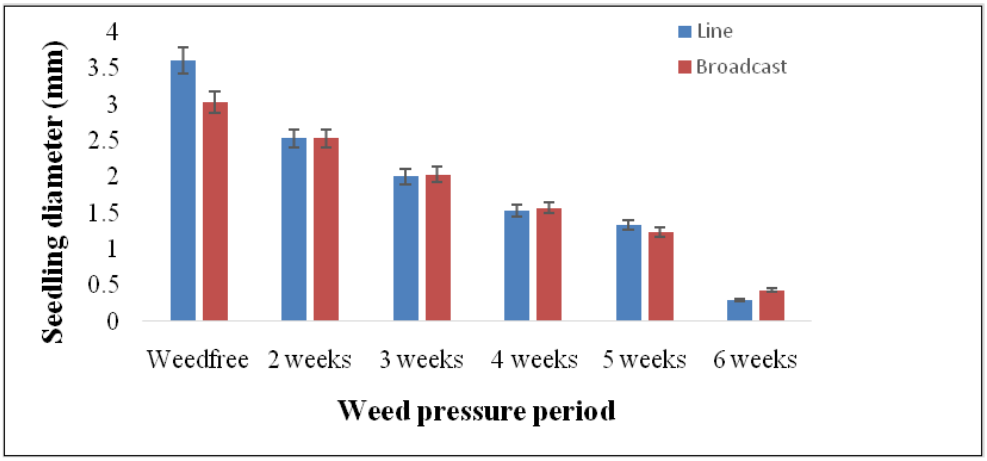

Fig. 2. Effects of sowing method and weed competition on stem diameter of onion seedlings Vertical bars represent standard error bars of means.

This could be because onions are affected by weed competition early in their life. The critical period for weed control in onions ranges between 15 and 60days after planting depending on weed densities, agronomic practices and climatic conditions (Singh and Singh, 1994). Any delays in weed control will lead to reduced growth and yield of onion as nutrients are taken up by weeds at the expense of seedlings. Some weeds such as the common purslane and purple nutsedge may exert part of their adverse effect by producing their allelopathic effects, which further reduces crop vigor (Hewson and Roberts, 1989). The presence of these weeds species was also observed in the experimental plots.

Weed density

No significant differences were observed between the methods of sowing with respect to weed density ($P>0.05$). However, significant differences were observed among the different weed pressure periods ($P<0.05$).

Weed density increased as the period of weed pressure increased to a maximum of 160 and 164 weeds per m^2 for the line and broadcasting method respectively at 6 weeks of weed pressure (Fig. 3).

The late emerging weeds resulted in the increase in weed densities with increased weed pressure period. These results concur with those of Jean-Simon *et al.* (2012) who also observed an increase in weed density with an increase in weed competition period. No interactions were observed between methods of sowing and weed pressure.

Weed dry weight

Sowing method had no significant effect ($p>0.05$) on dry weight of the weeds. However, significant effect was observed among the weed pressure periods ($P<0.01$). The results indicate an increase in dry weight with increasing weed pressure period.

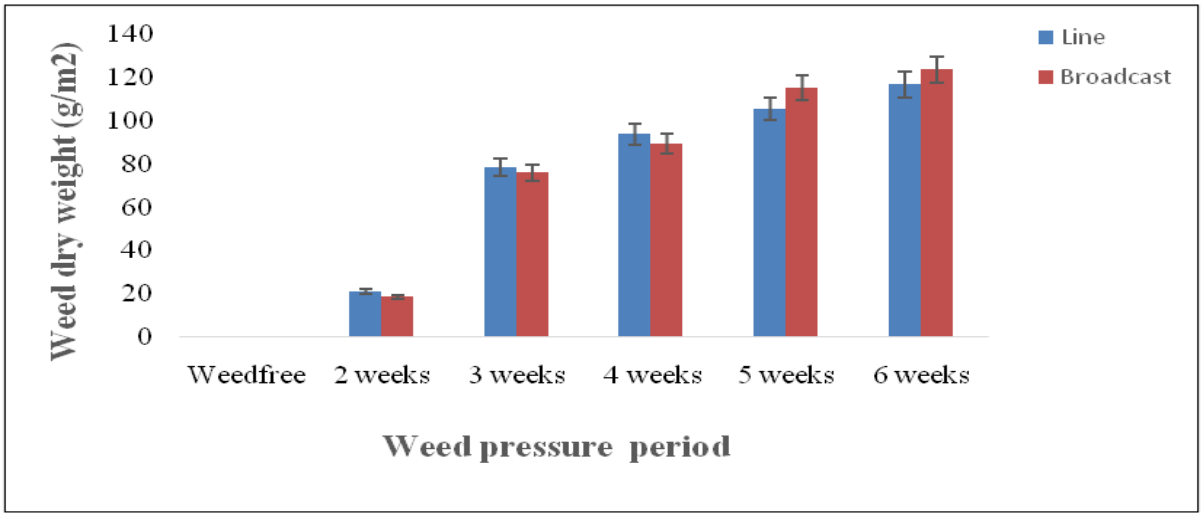

Fig. 3. Effect of sowing method and weed competition on weed density Vertical bars represent standard error bars of means.

The continuous weed pressure period (week 6) had the highest weed weight in both sowing methods (Fig. 4). Hewson and Roberts, (1973) reported that the onset of the weed critical period is when fresh weight of the weeds begin to increase rapidly which they noted to be five to six weeks after crop emergence. This trend was also observed in this experiment (Figure 4). No interactions were observed between sowing methods and weed pressure periods.

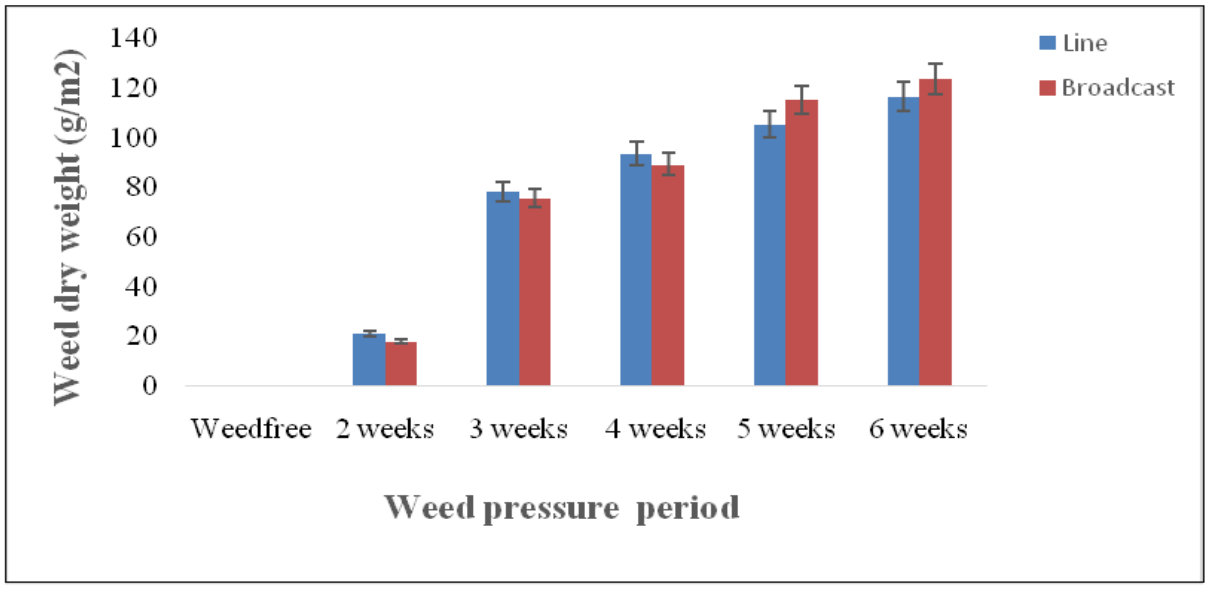

Fig. 4. Effect of sowing method and weed competition on weed dry weight Vertical bars represent standard error bars of means.

Seedling number

Broadcast and line sowing had no significant effect ($P>0.05$) on the number of seedlings amongst all treatments. However, significant differences were observed amongst the different weed pressure periods ($P<0.05$).

The weed free treatment recorded the highest number of seedlings in both the line and broadcast methods and the number decreased as the weed pressure period increased such that in week six very few seedlings were obtained (Fig. 5).

This could be attributed to increased competition for light and nutrients with increased weed pressure. Competing weeds can reduce as much as 85% of light intensity at crop level (Thomas and Wright, 1985). Severe competition for light between onion and nutsedge has been reported and it was suggested that the marked reduction in light intensity is an important factor affecting the survival of onion seedlings (Warid and Loazia, 1993). Nutsedge species were observed in this experiment.

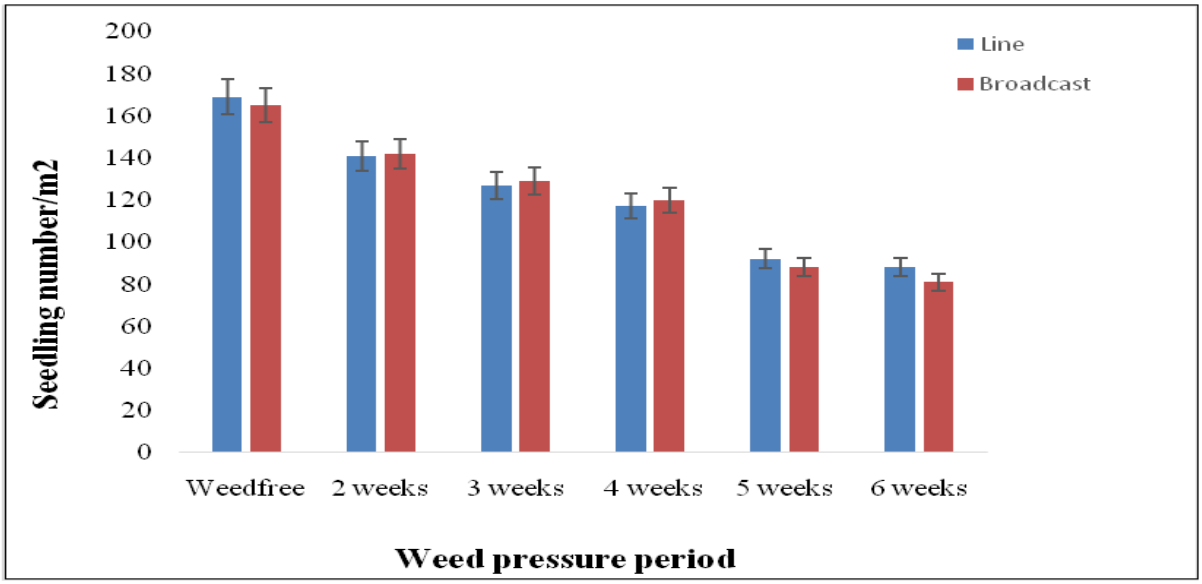

Fig. 5. Effect of sowing method and weed competition on seedling number Vertical bars represent standard error bars of means.

Seedling weight

The method of sowing significantly ($p<0.05$) affected seedling weight, with line method having a higher seedling weight from week one up to week three of weed pressure (Fig. 6). Thereafter no significant differences were observed ($p>0.05$). There was significant effect ($P= 0.01$) on seedling weight and the weed free treatments had the highest weight of seedlings and the least was recorded in the sixth week of weed pressure.

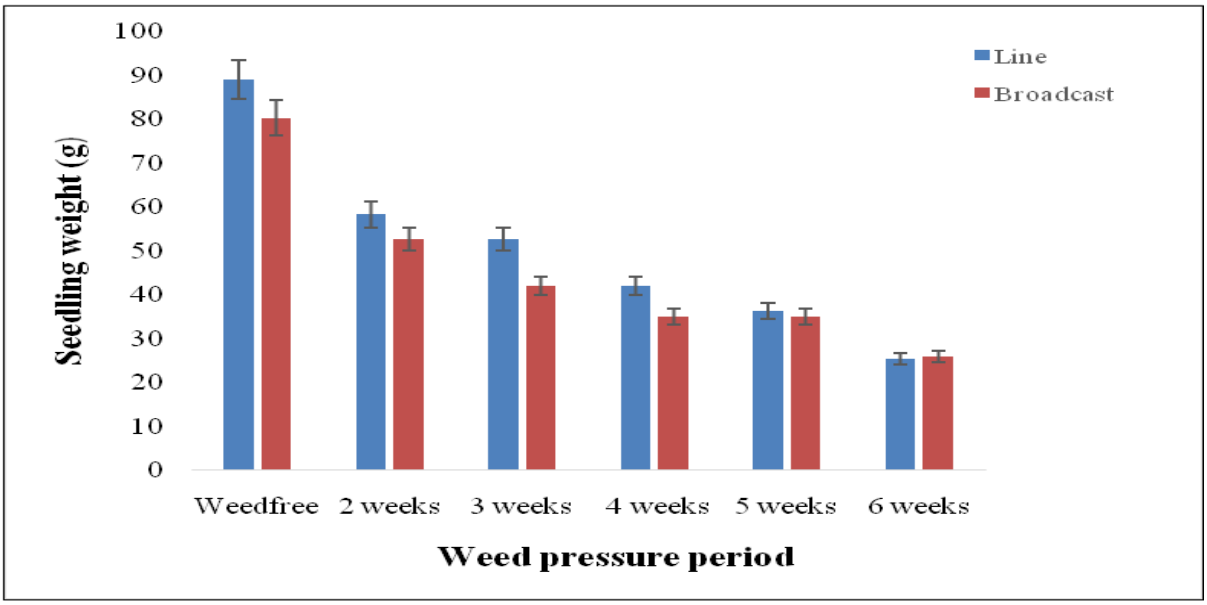

Fig. 6. Effect of sowing method and weed competition on seedling weight at transplanting Vertical bars represent standard error bars of means.

The results in this study showed that weed pressure significantly ($P<0.01$) affected seedling weight (Fig. 6).

The greatest reduction in seedling weight was observed when the weeds were allowed to continuously grow. This was probably due to lack of adequate nutrients since the seedlings were competing for nutrients with the weeds.

In the early stages of development, Alliciae crops have both slow growth rate and thin foliage therefore these plants are considerably weaker competitors than most crops (Singh, 1999). Shadbolt and Holm (1956) found that competition by a mixture of broadleaf and grass weeds for 2, 4, 6 or 8 weeks after onion emergence reduced yield by 20, 20, 40 and 65 % respectively. The same trend was observed in this experiment.

Line method of sowing performed better than the broadcast method during the first four weeks of weed pressure (Figure 6)but as the weed pressure period increased no significant differences were observed between the two methods ($P>0.05$).

This may be because during the early stage of competition seedlings in broadcast sowing method were competing for more space than the line method and as the competition period increased the line method became affected by the increased competition. Williams *et al.* (1973) also found that no yield is obtained from plots with full season weed competition at any tested spacing.

Conclusion

Weed pressure significantly reduced growth and quality of onion seedlings. All growth parameters were reduced when weeds were allowed to compete with onion seedlings and the effect increased with increased weed competition period. Line sowing method is recommended where weed free conditions can be maintained, as it is appropriate and easier to manage. Keeping the onion seedling weed free is also recommended as weed competition reduced growth and quality of seedlings. Further research should be carried out to investigate how these seedlings will perform when transplanted in the field.

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