academicJournals

Vol. 5(3), pp. 14-20, March, 2015
DOI: 10.5897/ISABB-JFAS2015.0020
Article Number: FA8945851332
ISSN 1937-3244
Copyright © 2015
Author(s) retain the copyright of this article
http://www.academicjournals.org/ISABB-JFAS

ISABB-Journal of Food and Agricultural Science

Full Length Research Paper

Effect of weed interference period on yield of transplanted tomato (*Lycopersicon Esculentum* M.) in Guder West Shewa-Oromia, Ethiopia

Tesfaye Amare, Frehiwot Sileshi and Ibrahim Hamza

Department of Plant Sciences and Horticulture, Ambo University College of Agriculture and Veterinary Science, P.O.Box 19, Ambo, Ethiopia.

Received 2 February, 2015; Accepted 5 March, 2015

A field experiment was conducted for two consecutive cropping seasons (2013 and 2014) to estimate effect of weed interference period on transplanted tomato (*Lycopersicon esculentum* M.) in Guder West Shewa, Ethiopia. The experiment consisted of 14 treatments laid out in RCBD with three replications. From the total weed species, 81.81% were broadleaved weeds whereas 9.09 and 9.1% were sedges and grass weeds, respectively. During 2014 cropping season of the total weed flora, 83.3% were broad leaved weeds, 8.33 and 8.33% were sedges and grass weeds, respectively. Two years pooled data revealed that, density, weed dry biomass, tomato yield and relative yield loss were observed in all the two years. The lowest weed density was recorded in plot kept weed free, plot harvest (0.0 and 0.0 m^{-2}) whereas the highest was recorded in no-weeded up to harvest (146.51, 161.33 m^{-2}) in 2013 and 2014, respectively. Similarly, lowest (0.0, 0.0 gm^{-2}) dry weight of weeds was recorded in weed free, whereas the highest was recorded in no-weeded up to harvest (1127.2, 1093.2 gm^{-2}) in 2013 and 2014, respectively. The highest yield (32.04, 29.57 tons ha^{-1}) was recorded in weed free plot which is not statistically significant with weed free up to 90 days after transplanting (DAT) (28.336, 31.511 tons ha^{-1}) and no-weeded up to 15 DAT (29.894, 27.484 tons ha^{-1}), whereas the lowest (4.00, 2.59 tons ha^{-1}) was recorded from no-weeded up to harvest, respectively. Uninterrupted weed growth caused a reduction of (87.5, 90.8%), in tomato yield as compared to complete weed free in 2013 and 2014, respectively.

Key words: Weed interference period, tomato yield, weed growth, yield loss.

INTRODUCTION

Tomato is a popular and widely grown vegetable crop in Ethiopia, ranking 8th in terms of annual national production (Jiregna et al., 2011). It is an important cash generating crop for small scale farmers and also provides employment in production and processing industries (Jiregna et al., 2011). Despite the importance of tomato in Ethiopia, the average yield is low, ranging from 6.5-24.0 Mg ha^{-1} as compared with average yields of 51, 41, 36 and 34 Mg ha^{-1} in America, Europe, Asia and the entire world, respectively (FAOSTAT, 2010). Of all the constraints limiting tomato production, weeds appear to have the most deleterious effect causing yield reduction (Sanok et

*Corresponding author. E-mail: tesfaalemamare@yahoo.com.

Author(s) agree that this article remain permanently open access under the terms of the Creative Commons Attribution License 4.0International License

al., 1979; Usoroh, 198;, Sinha and Lagoke, 1984).

Weeds reduce yields by competing for space, light, water and nutrients, weakening crop stand and reduce harvest efficiency (Abbasi et al., 2013). Some weeds can also increase other pest problems by serving as alternate hosts for insects, diseases or nematodes. The weed control methods practiced in tomato production include cultural, mechanical, chemical methods and integrated weed management (Ashton and Monaco, 1991).

However, the first bench mark to design successful weed management plan is determining effect of weeds and yield losses caused by weeds is very important. Weeds appear to have the most deleterious effect causing yield reduction of between 53 and 67% in Maryland (Sanok et al., 1979; Usoroh, 1983; Sinha and Lagoke, 1984), 80% (Weaver et al., 1984), 40 to 82% in Nigeria (Adigun et al., 1993) and 70% in Pakistan (Bakht and Khan, 2014). From the above research conducted, it can be concluded that effect of weeds and their respective yield loss in tomato crop varies depending on the type and density of weeds, competitive ability of crops and agro-ecology of that particular area. By considering climate and weed composition variability from one area to another and lack of research work regarding effect of weed growth on tomato yield and yield component in the country, the objective of this study was to determine the effect of weed interference period on transplanted tomato yield and yield components .

MATERIALS AND METHODS

Field experiment was conducted in Guder which is located in the west Shewa Zone of the Oromia Region of Ethiopia. It is located 12 km west of Ambo, this town has a latitude and longitude of 8°58′N 37°46′E, with an elevation of 2101 m above sea level. The average annual rainfall is 1081 mm. The mean annual minimum and maximum temperatures are 8.25 and 23.4°C, respectively.

Field experiment comprised of fourteen treatments undertaken during 2013 and 2014 growing season. The experimental design was randomized complete block design with three replications. Two types of weed interference (early and late weed crop competition) treatments were implemented after transplanting. Weed removal was started immediately after transplanting and the plots were kept weed-free up to harvest, 15, 30, 45, 60, 75 and 90 days after transplanting by periodic hand hoeing. The second set of treatments weeds were competing with tomato for up to harvest, 15, 30, 45, 60, 75 and 90 days after transplanting. Control plots were kept free of weeds or left weedy throughout the growth period (days after transplanting). Naturally occurring weed populations were utilized during the study period. The plot size was 3.5 × 3 m, 70 cm between rows and 30 cm between plants. 200 kg/ha DAP and 150 kg/ha urea, all the diammonium phosphate and 50% of urea was applied at time of transplanting, the other 50% a half months after transplanting.

Pre demarked ten plants were selected randomly in each treatment and their branches per plant and plant height were recorded and then average was calculated. The harvested fruit was weighed in each picking in kilograms and the cumulative data was converted into tone ha^{-1}. The randomly selected sampling points were marked with sticks at four corners to locate them later for data collection. Weed composition and weed density were recorded using quadrate measuring 0.5 x 0.5 m thrown at random on three sampling points in each plot. The above ground weed dry of mixed weed population was harvested and oven dried at 80°C for 30 h until constant reading was maintained to measure the above ground dry weights. Yield loss was calculated for each year separately as follows:

$$\mathrm{Re}\,lative = \frac{Yield\ \ from\, weedfree - Yield\ \ from\, treated\ \ plot}{Yield\ \ from\, weed\ \ free\ plot}\, X100$$

All data were subjected to analysis of variance using the SAS PROC GLM computer software package (SAS, 2009). Mean separation was conducted to test significant difference among treatment means using least significant differences (LSD) at 5% probability level.

RESULTS AND DISCUSSION

Weed composition of the experimental site during 2013 and 2014 cropping season

During 2013 cropping season, the experimental site was infested with 11 weed species belonging to 9 families identified. Among these, 81.81% were broadleaved, 9.09 and 9.1% were sedges and grass weeds, respectively. During 2014 cropping season, the experimental site was infested with 12 weed species belonging to 8 families. Of the total weed community, 83.3% were broad leaved, 8.33 and 8.33 % were sedges and grass weeds, respectively (Table 1).

Weed density

Data pertaining to the effect of different weed crop competition periods on weed density (m^{-2}) (Table 2) show that there were significant differences among all the treatments. During 2013 cropping season, maximum number of weeds m^{-2} (146.51) were counted in plots where weeds were allowed to compete with crop for full growing season which was significantly different from no-weeded up to 90 days after transplanting. On the other hand, minimum weed population m^{-2} (0.0) was observed in weed free up harvest which was not significantly different from no-weeded up to 15 days after transplanting (0.0). The number of weeds gradually increased as the duration of weed crop association increased. Contrarily, the number of weeds gradually decreased as the duration of weed free association increased. Increased in weed population with prolonged competition period may be due to the extra time availed by weeds to germinate and continue their growth. Similar trend was also observed in 2014 cropping season. These results are in line with those of Zafar et al. (2010) who reported that there was an increase in weed population and biomass with an increase in weed-crop competition period.

Table 1. Weed composition of the experimental sites during 2013 and 2014 cropping season

S/N	2013		2014	
	Botanical name	**Family name**	**Botanical name**	**Family name**
1	*Amaranthus hybridus* L.	Amaranthaceae	*Amaranthus spp.*	Amaranthaceae
2	*Bidens pilosa* L.	Asteraceae	*Amaranthus hybridus* L.	Amaranthaceae
3	*Chenopodium procerum* (Hochst ex.) Moq.	Chenopodiaceae	*Bidens pilosa* L.	Asteraceae
4	*Commelina bengnalensis* L.	Commelineae	*Commelina bengnalensis* L.	Commelineae
5	*Cyperus esculentus* L.	Cyperaceae	*Cyperus esculentus* L.	Cyperaceae
6	*Datura stramonium* L.		*Datura stramonium* L.	
7	*Digitaria abyssinica* (A. Rich.) Stapf	Poaceae	*Digitaria abyssinica* (A. Rich.) Stapf	Poaceae
8	*Galinsoga parviflora* Cav.	Asteraceae	*Galinsoga parviflora* Cav.	Asteraceae
9	*Guizotia scabra* (Vis.) Chiov.	Asteraceae	*Guizotia scabra* (Vis.) Chiov.	Asteraceae
10	*Nicandra physalodes* Scop.		*Ipomea ariocarpa*	Convolvulaceae
11	*Polygonum nepalense* Meisn.	Polygonaceae	*Nicandra physalodes* Scop.	
12			*Raphanus raphanistrum* L	Brassicaceae

Table 2. Effect of different periods of weed-free and weed interference period on weed density and dry biomass in tomato field during 2013 and 2014 cropping season.

Treatments	Weed density (m^{-2})		Weed biomass (gm^{-2})	
	2013	**2014**	**2013**	**2014**
weed free up to 15 DAT	114.33bc	127.0b	1104.7a	610.13c
weed free up to 30 DAT	97.0cde	98.67d	707.5b	315.33de
weed free up to 45 DAT	92.67e	80.00e	682.9b	251.87ef
weed free up to 60 DAT	74.00f	61.33ef	554.9b	204.40f
weed free up to 75 DAT	49.33g	30.67g	202.7c	107.47g
weed free up to 90 DAT	40.00g	24.67g	204.3c	106.80g
weed free up to Harvest	0.0h	0.0h	0.0c	0.0h
no-weeded up to 15 DAT	0.0h	0.0h	0.0c	0.0h
no-weeded up to 30 DAT	97.8cde	51.33f	80.1c	62.13gh
no-weeded up to 45 DAT	94.13de	66.67ef	151.1c	108.67
no-weeded up to 60 DAT	111.2bcd	103.0cd	554.7b	335.47d
no-weeded up to 75 DAT	116.37b	117.7bc	802.4b	578.00c
no-weeded up to 90 DAT	148.40a	119.3bc	1159.5a	919.33b
no-weeded up to harvest	146.510a	161.33a	1227.2a	1093.20a
LSD(0.05)	18.26	16.36	273.59	79.31
CV	12.89	13.10	23.71	14.09

LSD= least significant difference, CV= coefficient of variation, DAT = days after transplanting.

Weed dry weight

Effect of different weed crop competition period on weed dry weight (g m^{-2}) was significant in both cropping season. Full season weedy plot produced highest weed dry weight (1227.2, 1093.20 gm^{-2}) whereas the minimum was recorded from weed free plot up harvest (0.0, 0.0 gm^{-2}) during 2013 and 2014 cropping season, respectively. The data in Table 2 indicated that increment of weed free period was increased; there was significant reduction in weed dry biomass. This may be due to lowest weed density and short time of weed crop association to accumulate weed dry weight. This result is in agreement with the work of Ghosheh et al. (2010) who reported that weed biomass was much higher in weedy plots.

Plant height and branch number per plant

Effect of different weed crop interference and free period on plant was no significant (Table 3) in both cropping

Table 3. Crop response to different periods of crop in weed-free and weed interference treatments in tomato during 2013 and 2014 cropping season.

Treatments	Plant height (cm)		Branch No./plant		Yield (tonsha^{-1})	
	2013	2014	2013	2014	2013	2014
weed up to 15 DAT	74.4	70.5	5.4fg	6.6h	9.11ef	7.41de
weed free up to 30 DAT	70.2	67.9	11.7e	10.8g	11.93def	13.05cd
weed free up to 45 DAT	74.7	72.9	16.9cd	16.2de	15.17cd	24.52ab
weed free up to 60 DAT	75.4	71.1	18.1bc	18.8bcd	22.34b	26.02ab
weed free up to 75 DAT	70.7	68.7	18.4bc	19.9bc	28.05a	28.34a
weed free up to 90 DAT	70.1	62.4	20.4ab	20.7bc	31.51a	28.75a
weed free up to Harvest	69.1	67.9	23.5a	24.1a	32.04a	29.57a
no-weeded up to 15 DAT	63.7	68.9	22.2a	22.1ab	29.89a	27.48ab
no-weeded up to 30 DAT	63.7	63.3	18.3bc	17.7cd	16.46c	18.93bc
no-weeded up to 45 DAT	69.2	69.6	13.9de	14.2ef	12.58cde	13.37cd
no-weeded up to 60 DAT	68.0	61.2	8.2f	11.0fg	9.17ef	6.70de
no-weeded up to 75 DAT	67.4	61.5	5.0fg	6.4h	7.73fg	5.88de
no-weeded up to 90 DAT	73.6	63.4	3.6gh	4.6h	7.70fg	4.79de
no-weeded up to harvest	66.4	66.4	1.33h	3.8h	4.00g	2.59e
LSD(0.05)	NS	NS	2.06	3.39	4.28	9.3696
CV	10.75	11.72	15.36	14.38	15.03	32.92

LSD= least significant difference, CV= coefficient of variation, DAT = days after transplanting.

season. This might be due to the plenty of growth factor in weed free plot that allowed the plant to attain its maximum and the competition between weed and crop for the light helps it to grow to its maximum height.

Unlike the plant height, data presented in the Table 3 shows that branch number per plant was significantly affected by the treatments in both years. The maximum number of branches per plant (23.5, 24.1) was recorded in weed free up to harvest, whereas the minimum was recorded from plot that did not receive any weed control (1.3, 3.8) in 2013 and 2014 cropping season, respectively. This maximum branch number per plant in weed free up to harvest may be as a result of low density and dry weight of weeds and more space to produce as compared to the others.

Tomato yield

As shown in Table 3, tomato fruit yield was significantly affected by weed crop competition. During 2013 and 2014, the highest yield (32.04, 29.57 tonsha^{-1}) were recorded in weed free plot which is not statistically significant with weed free up to 90 DAT (28.336, 31.511 tons ha^{-1}) and no-weeded up to 15 days after transplanting (29.894, 27.484 tons ha^{-1}), whereas the lowest (4.00, 2.59 tons ha^{-1}) was recorded from no-weeded up to harvest, respectively. This might be due to lowest weed density and dry weight in weed free plot followed by weed free up to 90 DAT and no-weeded 15 days after transplanting. And the fruit yield was lowest in no-weeded up to harvest; this might due to the fact that, allowing weeds to grow fully could compete for water, nutrient and space thus, yield and yield component of tomato was reduced. As weed free period was increased, there was increase in the fruit yield of tomato, contrarily as no-weeded period also increased, there was reduction in fruit yield of tomato; this could be due to the fact that as no-weeded period increased, there was increase in weed density and biomass which can compete with crop by growth factors like nutrient, water and space. These results are in accordance with work of Ghosheh et al. (2010) and Ngouajio et al. (2001) indicating that low and moderate weed interference plots produced more tomato fruit quantities than amounts harvested from weedy plots. Similarly, the work of Adigun (2005) stated that fruit tomato yield were significantly, affected by the period of weed interference.

Figure 1 shows the relationship between tomato yield and weed dry weight. And tomato yield was inversely related with weed dry weight. As the weed dry weight increased, there was reduction in tomato yield during 2013 and 2014 cropping season.

Furthermore, Figure 2 also show the relationship between tomato yield and weed dry weight. And tomato yield was inversely related with weed dry weight. As the weed dry weight increased, there was reduction in tomato yield during 2013 and 2014 cropping season. It has been previously determined that crop yields tend to be reduced as weed dry weight increases accounting for an inverse relationship (Amador-Ramírez et al., 2005).

Relative yield loss

Data on the relative yield loss (%) as presented in Table 4

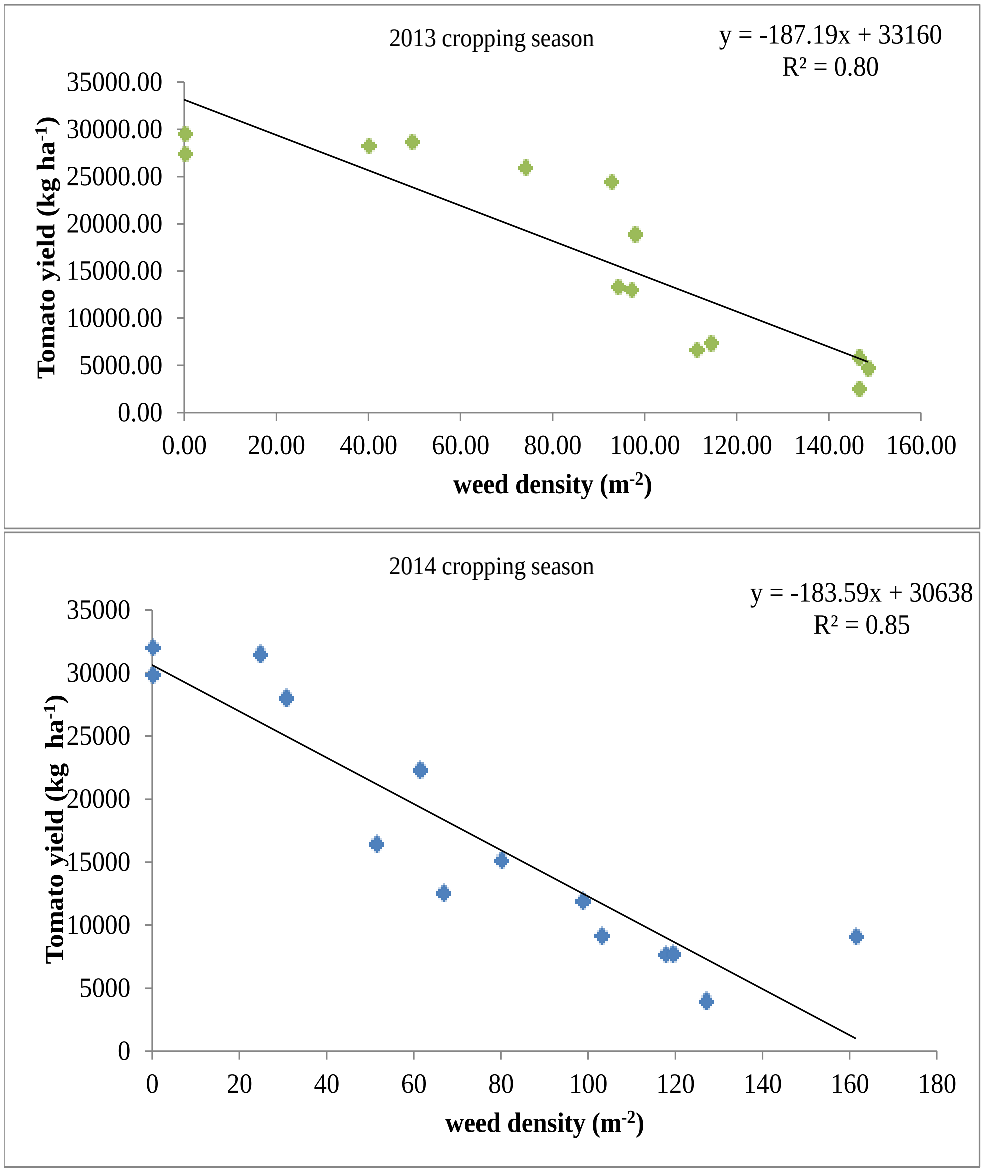

Figure 1. Relationship between tomato yield and weed density.

indicated that there was difference among the treatments. In the late competition, the highest relative yield (71.5, 74.9%) was recorded from weed free up to 15 days after transplanting, whereas the lowest was recorded from weed free plot up to harvest (0.00 and 0.00%) which was not statistically significant from weed free up to 90 days after transplanting (1.4 and 3.2%) in 2013 and 2014 cropping season, respectively. This may be due to higher weed crop competition for the growth and development factor (nutrient, water and space) and higher density and dry biomass in weed free up to 15 days after transplanting. These results are in agreement with Adigun et al. (1993) and Adigun (2005). Weed infestation throughout the crop life-cycle resulted in about 40 to 60% reduction in potential tomato fruit yield.

Moreover in early competition, also the relative yield loss was significantly affected by treatment. Data in Table 4 showed the lowest relative yield losses (6.6 and 6.4%), whereas the highest was recorded from no-weeded up to harvest (87.5 and 90.8%) in 2013 and 2014 cropping season, respectively. This may be due to lower weed crop competition for the growth and development factor (nutrient, water and space) and lowered density and dry biomass of weeds in no-weeded up to 15 days after transplanting. While comparing the cropping season, the highest yield losses was recorded during 2014 cropping season because there was higher density and biomass of weeds as compared to 2013 cropping season. Generally, increased weed free period, the yield loss decreased as time increased. This indicated that the competitive ability

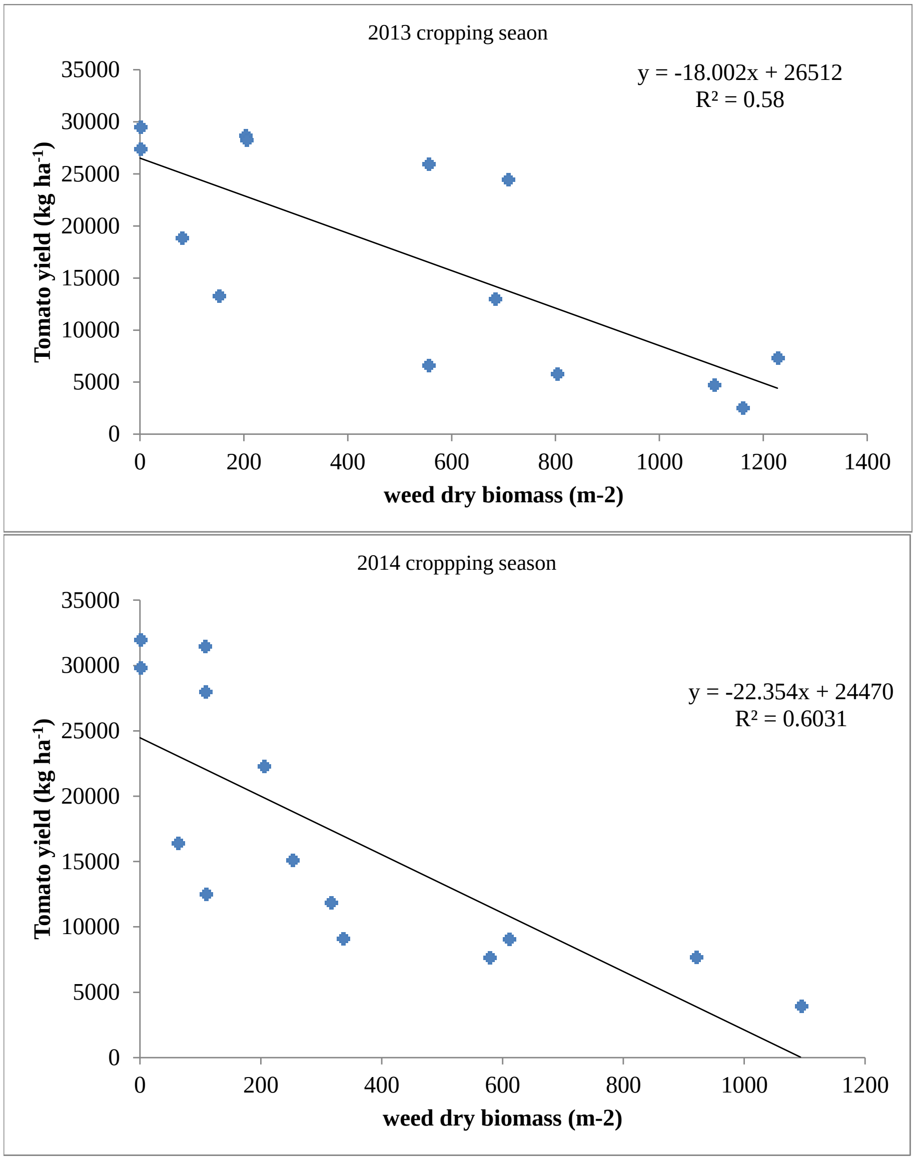

Figure 2. Relationship between tomato yield and weed dry weight.

Table 4. Relative yield loss of treated plots as compared to complete weed free plot

Late competition (weed free up to)	Yield loss 2013	Yield loss 2014	Early competition (weedy up to)	Yield loss 2013	Yield loss 2014
15 DAT	71.5a	74.9a	15 DAT	6.6e	6.4e
30 DAT	60.3b	54.4b	30 DAT	48.8d	34.2cd
45 DAT	52.4c	17.7c	45 DAT	60.8cd	51.9bc
60 DAT	30.2d	13.3cd	60 DAT	71.3bc	74.9ab
75 DAT	12.5e	4.4cd	75 DAT	75.9ab	79.7ab
90 DAT	1.4f	3.2d	90 DAT	75.9ab	82.3a
Complete weed free	0.0f	0.0d	weed check	87.5a	90.8a
LSD (0.05)	7.58	13.53	LSD (0.05)	12.56	29.91
CV	13.05	31.71	CV	11.59	27.99

LSD = Least significant difference, CV = coefficient of variation, DAT = days after transplanting.

of a given density of weeds which emerged with the crop and their dry matter production was strongly dependent the yield loss in early competition increased with increased time of weed interference whereas in the on the length of the period they remained in the field with tomato.

Conclusion

Two years pooled data revealed that, weed density, weed dry biomass, tomato yield and relative yield loss were observed in the two years. The lowest weed density was recorded in plot kept weed free harvest (0.0 and 0.0 m^{-2}), whereas the highest was recorded in no-weeded up to harvest (146.51 and 161.33 m^{-2}) in 2013 and 2014, respectively. Similarly, lowest (0.0, 0.0 gm^{-2}) dry weight of weeds was seen in weed free, whereas the highest was recorded in no-weeded up to harvest (1127.2 and 1093.2 gm^{-2}). The highest yield (32.04 and 29.57 tons ha^{-1}) were recorded in weed free plot which is not statistically significant with weed free up to 90 days after transplanting (28.336 and 31.511 tons ha^{-1}) and no-weeded up to 15 days after transplanting (29.894 and 27.484 tons ha^{-1}), whereas the lowest (4.00 and 2.59 tons ha^{-1}) was recorded in no-weeded up to harvest, respectively. Uninterrupted weed growth caused a reduction of (87.5 and 90.8%) in 2013 and 2014, respectively, in yield as compared to complete weed free. Therefore, early weed control is very important in order to reduce tomato yield loss.

Conflict of interests

The authors did not declare any conflict of interest.

ACKNOWLEDGEMENTS

The authors wish to thank the management and the staff of Plant Science Department of Ambo University. Special thanks are also extended to the Ambo University for their financial support in conducting the experiment.

REFERENCES

Abbasi NA, Zafar L, Khan HA, Qureshi AA (2013). Effects of weeds on growth, yield and post harvest performance of tomato fruit. Pak. J. Bot. 45(5):1581-1587.

Adigun JA (2005). Critical Period of Weed Interference in Rainfed and Irrigated Tomatoes in the Nigerian Savanna. Agric. Trop. Subtrop. 38:2.

Adigun JA, Lagoke STO, Kumar V, Erinle ID (1993). Weed management studies in transplanted tomato in the Nigerian Savanna. Samaru J. Agric. Res. 10:29-39.

Amador-Ramírez MD, Velásquez-Valle R, Bravo-Lozano AG, Gutiérrez-Luna R (2005). Interference of Weeds on Growth and Yield of Transplanted Dry Chile Pepper. Horticulture Series 11 (1):73-81.

Ashton F, Monaco T (1991). Weed Science; Principles and Practices 3rd Edition A Wily Interscience Publication United Stated of America.

Bakht T, Khan IA (2014). Weed Control in Tomato (Lycopersicon Esculentum Mill.) Through Mulching and Herbicides. Pak. J. Bot. 46(1):289-292.

Ghosheh H, Mohammad AK, Ibrahim M (2010). Weed Competitiveness and Herbicidal Sensitivity of Grafted Tomatoes (Solanum Lycopersiconmill.). J. Plant Prot. Res. 50:3.

Jiregna T, Derbew B, Kassahun B (2012). Genetic Associations Analysis among Some Traits of Tomato (*Lycopersicon esculentum* Mill.) Genotypes in West Showa, Ethiopia. Int. J. Plant Breed. Genet. 6:129-139.

Ngouajio M, McGiffen ME, Hembree K (2001). Tolerance of tomato cultivars to velvetleaf interference. Weed Sci. 49(1):91-98.

Sanok WJ, Shelleck GW, Greighton JF (1979). Weed control and phytotoxity with herbicides in five tomato varieties. Proceedings of the North eastern weed science society. Department of Rort. University of Maryland, College Park 20742, USA,33:332 - 335.

SAS (2009). Statistical Analysis System Software. Ver. 9.0. SAS Institute Inc., Carry. NC.

Sinha TO, Lagoke STO (1984). Weed control in irrigated tomato (Lycopersicon esculentumnti/) in Northern Nigeria. Trop. Pest Manage. 30:1825.

Usoroh NJ (1979). Assesment of the critical period of weed Competition in tomato (*Lucopersicon esculentum* Mill) Proceedings of 9th Annual conference of weed science society of Nigeria.University of lfelle-Ife, Nigeria. 2-4 Dec. 1977, 62-65.

Weaver SE (1984). Critical period of weed competition in three vegetable crops in relation to management practices Weed Res. 24:313-325.

Zafar M, Tanveer A, Cheema ZA, Ashraf M (2010). Weed-crop competition effects on growth and yield of sugarcane planted using two methods. Pak. J. Bot. 42(2):815-823.