



Effect of Early Season Weed Competition Duration on Onion Yield

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Weeds are one of the main plant protection problems in onion fields. A field experiment was conducted at Mersan, South Haiti to determine the effect of early season weed competition duration on the yield of onion (*Allium cepa* L.). The experimental design was a randomized complete block of 7 treatments (weed-free from planting to harvest, weed competition up to 2, 4, 6, 8, or 10 weeks after planting, and weed competition from planting to harvesting) with 4 replications. Onion yield decreased as the duration of early season weed competition increased. Yield loss was 14.45% when weed removal was initiated at 2 weeks after transplanting the crop, and 87.66% when the onion crop was in the presence of weeds season long.

Onion (*Allium cepa* L.) is an important commercial vegetable crop in Haiti. It is consumed throughout the socioeconomic spectrum (Sumberg et al., 1994). During the period of 2006 to 2010, the area of onion harvested oscillated between 1,000 and 2,010 ha, and the national production between 5,400 and 10,000 MT (FAO, 2012).

Weeds are one of the main plant protection problems in onion fields. They compete with onions for light, nutrients, water, and space, and are also host plants of several harmful insects and pathogens (Uygur et al., 2010). Many authors have reported that onion plants are poor weed competitors (Carlson and Kirby, 2005; Dunan et al., 1996; Menges and Tamez, 1981; Qasem, 2006; Smith et al., 2008, 2011). The poor competitive ability of onion with weeds has been attributed to its initial slow growth and lack of adequate foliage to smother weeds (Wicks et al., 1973). Rajendra et al (1986) stressed onion's inherent characteristics such as short stature, non-branching habit, sparse foliage, shallow root system and extremely slow growth in initial stages. Bhalla and Patel (1983) reported reduction in bulb yields of 48% to 85%. Qasem (2005) obtained yield losses of 86% and 100% from weed-infested crops for the whole growing season.

In Haiti, onion producers rely primarily on manual weeding to remove flushes of weeds during the cropping season. This practice is laborious and time consuming. Also, research information on timing of weed control in onion is inadequate. Hence, this study was conducted to determine the length of competition tolerated after transplanting without yield loss in onion.

Materials and Methods

A field experiment was conducted during the period of Dec. 2005 to Apr. 2006 on a grower's farm at Mersan, South Haiti, located at 18°16'55.5" N latitude, 73°50'29.3" W longitude, and an altitude of 144 m above sea level. Average monthly temperature varies between 20 and 30 °C (MPCE, 1979). The average annual rainfall is around 2,200 mm (ORE, 2012). The soil of the experiment site was sandy-loam containing 9.4% clay, 22.7% silt, and 67.9% sand. The soil pH was 7.4.

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The experimental design was a randomized complete block of 7 treatments (weed-free from transplanting to harvest, weed competition up to 2, 4, 6, 8 or 10 weeks after transplanting, and weed competition from transplanting to harvesting) with 4 replications. The experimental unit was comprised of three double rows, 3 m long, with a spacing of 70 cm between rows. This translates into an area of 6.3 m² per experimental unit.

'Yellow Granex' onion seedlings were produced in nursery beds established in 9 Nov. 2005 and field transplanted on 30 Jan. 2006 at within-row spacing of 10 cm. The 12-12-20 NPK fertilizer was applied 10 d after transplanting (DAT) at a rate of 416.7 kg-ha⁻¹. Supplemental N in the form of Urea (46-0-0 NPK) was applied 43 DAT at the rate of 50 kg-ha⁻¹. Pest control measures consisted of two sprays of lambda-cyhalothrin for the control the insect pest *Spodoptera exigua* and of mancozeb for the prevention of fungal diseases. The experimental plots were harvested at 84 DAT.

The variables measured were weed densities of the dominant weed species (*Cyperus rotundus*, *Rottboellia cochinchinensis*, *Cleome viscosa*, and *Euphorbia heterophylla*) at first weeding, onion plant height and number of leaves per plant at 77 DAT, number of onion bulbs harvested per m², and onion yield. Onion bulbs were separated into small (diameter <5 cm) and medium-large (diameter >5 cm). Analysis of variance and least significance difference tests were performed at 5% alpha level.

Results and Discussions

The densities of the dominant weed species as affected by early season weed competition duration are depicted in Fig. 1. *Cyperus rotundus* density increased sharply as weed control was delayed to reach a maximum of 90 shoots per m² at 8 weeks after transplanting (WAT). Beyond 8 WAT, the density of *C. rotundus* decreased linearly to reach zero shoot per m² when the crop was in the presence of weeds season long. The density of *R. cochinchinensis* also increased sharply as weed control was delayed, and reached a maximum of 102 shoots per m² at 10 WAT, without significant difference from when the crop was in competition with weeds season long. *Cleome viscosa* and *E. heterophylla* reached maximums of 32 shoots per m² at 10 WAT, and 16 shoots per m² at 8 WAT, respectively, with significant decreases in shoot numbers

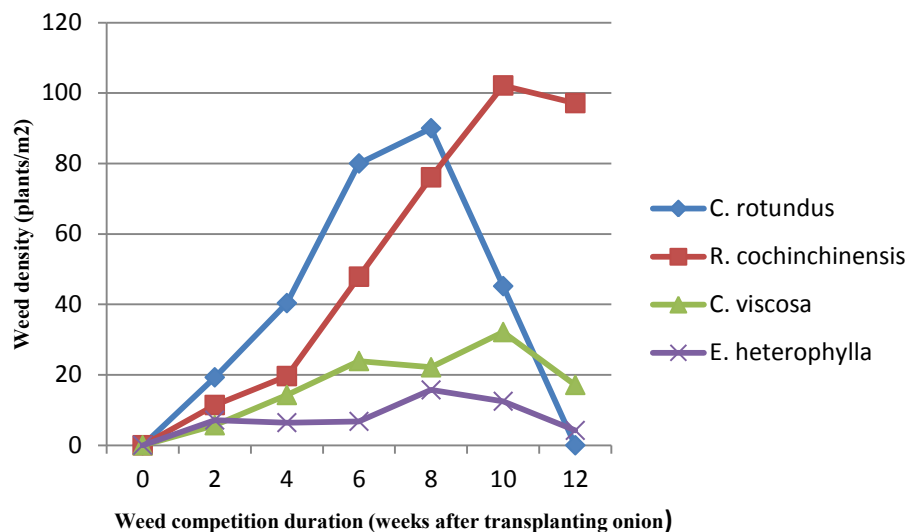


Fig. 1. Weed density as affected by early season weed competition duration.

when weed competition lasted season long. *R. cochinchinensis* plants seemed taller than the other weed species, which may be causing reduced light intensity and hampering growth. This effect seems to be more severe on *C. rotundus*. Pitty and Muñoz (1993) stressed the sensitivity of *C. rotundus* to the effect of shade.

Onion plant height and number of leaves per plant decreased linearly as weed control was delayed (Figs. 2 and 3). When the onion crop was in competition with weeds season long, there was a reduction of 55% in plant height and of 40% in number of leaves per plant compared with the weed free crop. Increased stem elongation is often an advantage for plants competing for light (Salisbury and Ross, 1985). Decrease in number of leaves per plant directly translates into decrease in leaf area index (LAI). Productivity rates decrease with decreased LAI because of less total light interception.

Bulb yield and bulb size were significantly influenced by the duration of early season weed competition (Table 1). There was no significant difference for total number of bulbs harvested

between the weed free check, weed competition up to 2 WAT, and weed competition up to 4 WAT. However, a 23% reduction in total number of bulbs harvested was recorded when weed control was initiated at 6 WAT. The maximum reduction in total bulbs harvested (67.7%) occurred when the onions were in competition with weeds throughout the crop cycle. There was no significant difference for the number of medium-large bulbs between the weed free check and weed competition up to 2 WAT. However, the number of medium-large bulbs was reduced by 60% when onions were in the presence of weeds up to 4 WAT. A reduction of 100% for medium-large bulbs occurred when weed competition lasted 8 WAT or more.

The highest total bulb weight (11.86 t·ha⁻¹) was achieved when the onions were kept weed free season long. Total yield loss was 14% when weed removal was initiated at 2 WAT and was 87% when the onion crop was in the presence of weeds season long. There was no significant difference between the weed free treatment and weed competition up to 2 WAT for medium-large size

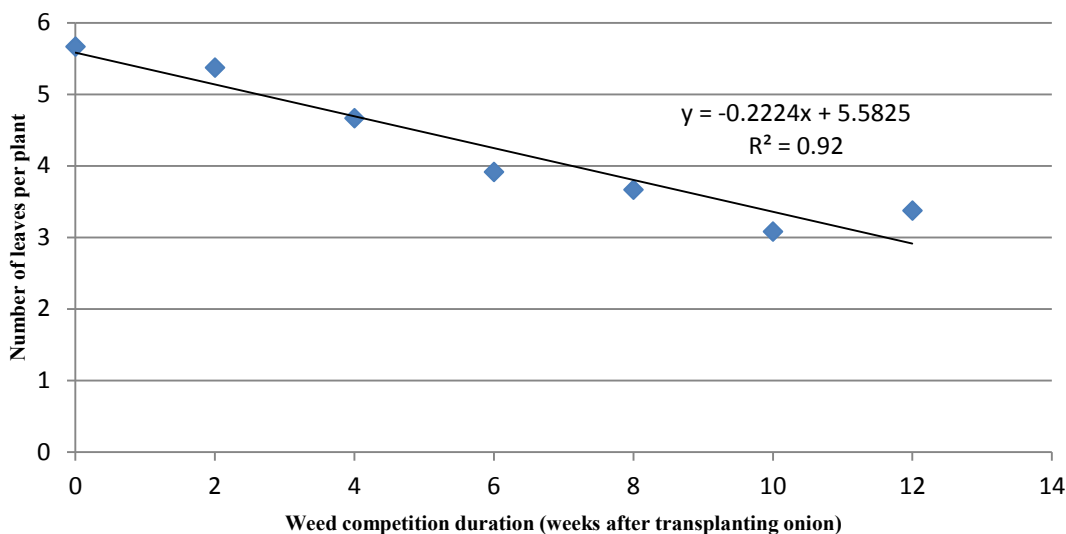


Fig. 2. Number of leaves per plant in onion as affected by early season weed competition duration.

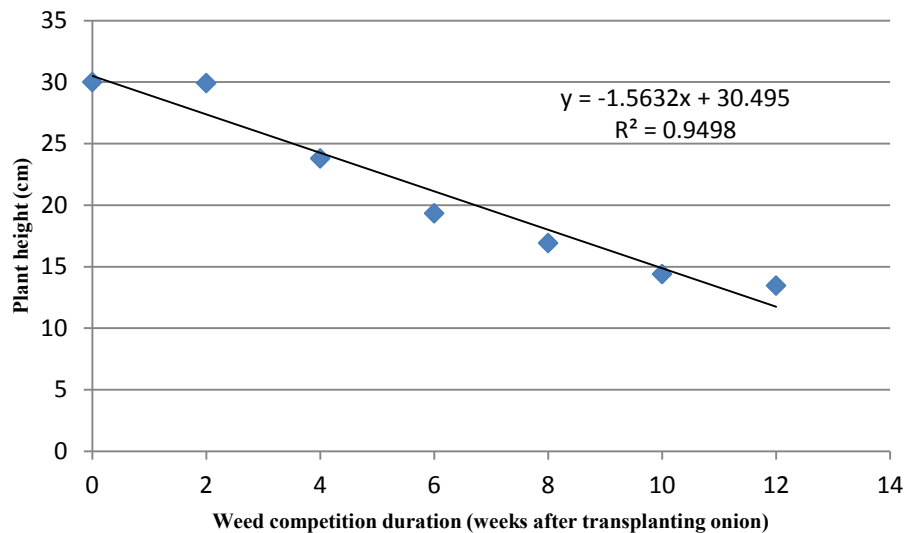


Fig. 3. Onion plant height as affected by early season weed competition duration.

Table 1. Onion yield as affected by duration of early season weed competition.

No. of weeks after transplanting ^z (WAT)	No. of bulbs harvested (bulbs per m ²)		Bulb wt (t·ha ⁻¹)	
	Total	Medium-large	Total	Medium-large
0	23.8	5.6	11.9	4.9
2	21.8	4.5	10.1	4.0
4	21.3	2.3	8.3	2.0
6	18.3	0.4	4.2	0.4
8	17.9	0.0	2.9	0.0
10	12.9	0.0	1.9	0.0
12	7.7	0.0	1.5	0.0
LSD 5%	4.1	2.3	1.5	2.1

bulb weight. However, a reduction in medium-large bulb weight of 60% occurred when weed removal was delayed until 4 WAT. Medium-large bulb weight reduction reached 100% when weed removal was delayed to 8 WAT or beyond, without significant difference with weed competition up to 4 WAT. The results of this experiment suggest that onion crops should be kept weed-free all season long.

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