Original scientific paper
10.7251/AGSY1404563A

INFLUENCE OF DIFFERENT IRRIGATION LEVELS ON THE GROWTH OF REDROOT PIGWEED (*Amaranthus Retroflexus* L.) AND JIMSONWEED (*Datura Stramonium* L.) UNDER DIFFERENT COMPETITION CONDITIONS

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Abstract

Growth of redroot pigweed and jimsonweed grown either alone or in competition with cotton and maize was evaluated under two irrigation levels. Plots were seeded with crops based on the regional growing practices and crops were grown until first irrigation date without weeds. Weed seeds were then sown on plots with or without crops 7-10 days prior to first irrigation date. Weed growth was then monitored weekly during whole irrigation period. At the end of the experiment, weeds were harvested and their mean fresh and dry weights were determined. Water use efficiency (WUE) and irrigation water use efficiency (IWUE) of weeds were determined.

Results showed that irrigation rates did not affect weed fresh and dry biomasses significantly both under non-competitive or competitive conditions. In both water conditions, weeds were significantly suppressed by the competition with crops. Results from both years showed, that water use efficiency and irrigation water use efficiencies of weeds were improved significantly under 50% irrigation water level. Results of these studies suggest that reduced irrigation would not cause important changes in terms of crop-weed competition in the case of cotton and maize crops, because at the beginning of irrigation crop species have great growth advantage over new emerged weed seedlings. However, changes in competition severities between crops and weeds can be expected at the earlier growth stages depending on soil water availability or in crops which are started to be irrigated earlier.

Key words: *water levels, weed-crop competition, cotton, maize*.

Introduction

Cotton and Maize are important summer crops grown in western part of Turkey and weeds are important yield limiting factors for both crops in the same region. Weed control in both crops should be carried out at early stages of growth to reduce the yield losses due to competition for resources such as water, nutrients as well as light. Therefore a weed free period starting from shortly after emergence until row closure is generally required to avoid weed based yield losses (Bükün 2004, Doğan et al., 2004).Irrigation is an important growing practice for the growth of both crops that is done mainly atthe end of critical period for weed control in both crops. However, it can still cause new weed emergences in late season which can be problem during harvest and/or reduce the quality of both crops. So late season weed control is also necessary in most cases to avoid such indirect effects of weeds.

Redroot pigweed (*Amaranthus retroflexus* L.) and jimsonweed (*Datura stramonium* L.) are important weeds found frequently in cotton and maize fields which are in most cases target weeds for these crops together with some other species. These species can be found in fields

in early stages and damage crops by means of competition, but also they emerge after irrigation and need to be controlled in most cases mechanically, especially by hand pulling. So they increase water demand on the field and cause extra cost for production.
Because water resources are being more critical during the last decades, special attempts have been put on the reduction of water use in agriculture currently. Deficit irrigation is one of these attempts aiming to reach potential crop yield with minimum water input. Since water is an important competition factor for both crops and weeds, it can be estimated that the growth of weeds can be affected by water supply as well. Therefore it was aimed in this study to evaluate the growth and water use efficiencies of above mentioned weed species at two water levels.

Material and Methods

Experiments were conducted at the Research Station of Adnan Menderes University, Faculty of Agriculture in Aydin province of Turkey in 2012 and 2013 growing seasons. In the study, a split plot design was used with three replications. A drip irrigation system was designated for the experiment. Irrigation water was supplied by a pump to the experimental site. Distribution lines consisted of PVC pipe manifolds for each plot. The diameters of the laterals were 16 mm PE and each lateral irrigated one plant row. The inline emitters were used with a discharge rate of 2 L/h above 10 m operating pressure. In the system, emitter and the lateral spacing were chosen as 0.25 and 0.70 m, respectively. Irrigation water was applied based on cumulative Class A-Pan evaporation within 4 day irrigation interval. There were 3 m between main blocks and each main block was receiving 100% and 50 % of the cumulative evaporation from Class A-Pan. Main blocks were then split into five sub plots. The total area of one main block was 630 m^2 and each sub plot was 33.6 m^2 at sowing. Treatments in each sub plots were:

Crop alone: maize or cotton crops were grown regularly without weeds. Weeds were removed from plots mechanically when required

Crop with redroot pigweed

Crop with jimsonweed

Maize or cotton crops were grown regularly without weeds until the first irrigation timing. About 1-2 weeks before first irrigation weed seeds were sown on two parallel 2 meters long rows on plots. After emergence weed seedlings were thinned one seedling between two crop plants (20-30 cm apart from each other) on each 2 meters row. In cases where no weed emergence occurred, weeds were also transplanted.

Redroot pigweed alone

Jimsonweed alone

These plots were kept crop and weed free until weed seeding time mentioned above for 2-3. Only weeds were grown on the plots without crops. Weed seeds were sown on two parallel 2 meters long lines on each plot. After emergence weeds were thinned to obtain one weed per 20-30 cm to simulate the distance between weeds as in the case of treatments 2 and 3.
Details to experiments were given in Table 1.

Table 1. Sowing, weed seeding, irrigation dates and amounts during experiments

Crop	Maize		Cotton	
Year	2012	2013	2012	2013
Sowing date	10.07*	08.05	08.05	22.05
Weed seeding date	24.07	22.05	20.06	14.06
Irrigation starting date	13.08	28.06	05.07	28.06
Irrigation end date	25.09	13.08	03.09	29.08
Total full irrigation amount (mm)	395	406	662	596

*second crop maize

Weed growth was followed weekly during whole irrigation period. At the end of the experiment weeds were harvested and their mean fresh and dry weights were determined. Since only weeds grown without competition produced considerable fresh and dry weights, water use efficiency (WUE) and irrigation water use efficiency (IWUE) of these weeds was calculated as below (Howell and Hiler, 1975)

Irrigation water use efficiency (IWUE) = Weed biomass (kg)/ irrigation water applied (mm)

Water use efficiency (WUE) = Weed biomass (kg)/Evapotranspration (mm)

All experimental data was subjected to ANOVA and differences between means were separated by using Standart Errors (SE) of estimation.

Results and Discussion

Fresh and dry biomasses of both weeds grown under two irrigation regimes alone or in competition with crops are shown in Table 2. Since year related interactions were not significant so data from both years was combined and jointly analyzed. Results showed that crops suppressed weeds significantly under both irrigation regimes, so that weed biomasses under competition were significantly lower as compared to weeds grown alone. Crop species (cotton and maize) were not differed in their suppressive abilities over weeds under both competition condition in both years so weed data from each crop was also combined and analyzed jointly.

Table 2. Fresh and dry biomass of jimsonweed and redroot pigweed as affected by irrigation rate and competition

	Jimsonweed				Redroot Pigweed			
Condition	Alone		In competition		Alone		In competition	
Irrigation rate	Full	Half	Full	Half	Full	Half	Full	Half
Fresh weight (kg/per individual)	1,92	2,88	0,10	0,08	1,48	1,52	0,12	0,22
SE	0,33		0,01		0,13		0,07	
Dry weight (kg/per individual)	1,32	1,43	0,02	0,02	0,32	0,33	0,01	0,01
SE	0,46		0,001		0,05		0,001	

Irrigation rate did not affect weed biomass in most cases under both competition conditions. Only fresh weight of jimsonweed grown without competition was significantly higher under half irrigation regime, while this difference was not obtained with dry weight parameter. In the case of redroot pigweed irrigation rates did not affect fresh or dry biomass of this weed significantly.

Irrigation water use efficiency (IWUE) and water use efficiencies (WUE) of both weeds grown alone are shown in Table 3. ANOVA results showed that water factor was significant, while year factor and year-water interaction were not. So data from both years were combined and analyzed jointly. Results showed that both WUE and IWUE values for weeds were significantly higher under half irrigation rate. So it can be concluded that both weeds use soil water more efficiently under limited water conditions.

Table 3. Irrigation water use efficiency (IWUE) and water use efficiencies (WUE) of Jimsonweed and Redroot pigweed as affected by irrigation rate and competition

	Water use efficiency (WUE)				Irrigation water use efficiency (IWUE)			
Condition	Jimsonweed		Redroot pigweed		Jimsonweed		Redroot pigweed	
Irrigation rate	Full	Half	Full	Half	Full	Half	Full	Half
	0,94	1,93	0,68	1,48	0,76	1,29	0,57	1,00
SE	0,17		0,15		0,12		0,11	

Results from these studies showed that both weeds were suppressed by either crop significantly regardless of irrigation rate. So, significant changes in competition cannot be expected based on these results. This can be attributed to the well development of above and underground parts of crops at the time of irrigation, which can make considerable advantage for crop growth and reverse for weeds. So, new emerged weeds can fail in most cases to catch the light, as well as to take water and some nutrients up from the soil. Results showed furthermore that amount of irrigation water did not affect weed biomass significantly when grown without competition. However, water use efficiencies of weeds were nearly doubled under 50% irrigation deficit conditions.

Although some studies have been conducted to investigate the effect of irrigation regimes on the growth and yield of some crops, studies concerning the effect of irrigation rate on weed growth are limited. In a similar study Pearcy et al. (1981) investigated the competition between two weed species redroot pigweed (C4 weed) and common lambsquartes (*Chenopodium album* L., C3 weed) under full and deficit irrigation systems and found that irrigation amount did not alter the competition between two weed species. So, these results are similar to the findings derived from this study. However, Ward et al. (1999) investigated the competition between redroot pigweed (C4 weed) and velvetleaf (*Abuthilon theoprastii* L. Medic., C3 weed) under drought and no water stress conditions and found that drought conditions favored by redroot pigweed in terms of competition.

Conclusion

Results of our studies suggest that weed growth cannot be significantly influenced by water conditions, but water use efficiencies of weeds can strongly be improved under deficit irrigation conditions. Since first irrigation is done at a date where crop species widely completed their vegetative growth, later emerging weeds cannot compete with crops effectively, so that irrigation water amount is insignificant at that crop growth stage. However, in case of some crops irrigated at earlier periods, such as vegetables, significant effects of irrigation water amount on crop-weed interactions are expected. This issue should be the aim of further studies.

Acknowledgement

Studies presented here was financially supported by Turkish Council for Scientific Research (TUBITAK) with project code 110 O 184-

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