International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 4, No. 3, p. 164-170, 2014

RESEARCH PAPER OPEN ACCESS

Common cocklebur (*Xanthium strumarium* L.) seed burial depth affecting corn (*Zea mays* L.) growth parameters

Rouhollah Amini*, Sahar Izadkhah, Adel Dabbagh Mohammadinasab, Yaegoob Raei

Department of Plant Ecophysiology, Faculty of Agriculture, University of Tabriz, Tabriz, 5166616471, Iran

Key words: Common cocklebur, corn, growth, wheat straw.

http://dx.doi.org/10.12692/ijb/4.3.164-170 Article published on February 14, 2014

Abstract

In order to assay the effects of common cocklebur (*Xanthium strumarium* L.) seed burial depth and wheat straw on corn (*Zea mays* L.) growth, an experiment was carried out at Research Farm of the Faculty of Agriculture, University of Tabriz, Iran in 2012. The factorial experiment was arranged based on randomized complete block design with three replications. The first factor was wheat straw application (control (0), 1.5 and 3 ton/ha) and the second factor was burial depth of common cocklebur seed (3, 6, 10, 15 and 20 cm) in the field. Result showed that the effects of wheat straw was significant on all corn traits and increased them. By increasing the cocklebur seed burial depth the all traits of corn were increased significantly except the chlorophyll content index. The interaction effect of wheat straw × burial depth was significant on corn height and cocklebur biomass. With increasing the wheat straw application and burial depth of cocklebur seed leaf number, chlorophyll content index and biological yield of corn were increased. Common cocklebur biomass was significantly reduced with increasing of wheat straw application and seed burial depth. As a result seed burial depth and application of straw could affect corn growth and competitive ability of cocklebur and could be used for management of this weed.

* **Corresponding Author:** Rouhollah Amini ✉ r_amini@tabrizu.ac.ir

Introduction

Corn (*Zea mays* L.) is cultivated across a wide range of environments, from extremely stressful to favourable. Maize being the third most important cereal crop after wheat and rice in Iran (Shamayeli, 2012). Integrated weed management systems require a comprehensive knowledge of weed biology and ecology (Buhler, 1999). Information on competitive interaction between weeds and crops are useful for developing and implementing effective weed management programs (Fu and Ashley, 2006). Along with other problematic weeds of maize, common cocklebur (*Xanthium strumarium* L.) is an emerging noxious weed of corn (Afzal *et al.*, 1994; Amini and Izadkhah, 2013). It inflicts severe yield losses in maize production in particular (Hussain *et al.*, 2011) probably due to its allelopathic effects (David *et al.*, 2005). Cocklebur species are more competitive because of their larger size causing severe yield reductions in maize (Royal *et al.*, 1997). Common cocklebur is found as the most competitive weeds in maize and other crops in the world's (Cavero *et al.,* 1999).

Burial depth of seed can affect seed germination, seedling growth and especially plant density in square meter. Crop competition with weeds can be enhanced by increasing the crop density in order to cover the soil surface and sequester more light and soil resources that might help suppress weeds like common cocklebur, as increase in weed density always reduced the biological yield of maize (Oljaca *et al.*, 2007). Under high plant population of maize, its leaf area index increased (Berzsenyi and Dang, 2007) and total biological yield was also greater but individual plant yield was higher at lower plant density (Randhawa, 1995). Hammad *et al.*, (2011) reported improvement in growth and yield of single plant in lower maize density but did not compensate the total yield obtained under higher density. Therefore, optimum crop density is one of the key factors for enhancing maize competitiveness, weed suppression ability and achieving higher yields (Shah *et al.*, 2011).

Soil characteristics also affect the availability of nutrients and water to crops and weeds. Seasonal climatic patternsalso determine when tillage and cultivation operations are possible, as well as the timing of crop and weed growth and resource use (Wicks *et al.,* 1994). Crop residues (straw) to soils are important because they are a major source of organic carbon and nutrients. Organic carbon positively impacts soil fertility, soil structure, water infiltration, water holding capacity, and bulk density, and it sustains microbial activity (Adamtey *et al.,* 2010). Above-ground crop residues also have many benefits in the field. They act as a physical barrier between the soil and the erosive forces of wind and rain, reduce evaporation, increase water infiltration, and serve as a nutrient source (Li *et al.,* 2013). Straw provides protection against wind and water erosion, residue influences nutrient cycling and fertilizer recommendations, and historically, many federal crop programs have required growers to submit a conservation plan that preserves a specified level of crop residue. Therefore, the objective of this study was to evaluate the effects of wheat straw application and different burial depth of common cocklebur seed on growth characteristics of corn and cocklebur biomass.

Material and methods

Site description and experimental design

This research was carried out at Research Farm of Tabriz University, Tabriz, Iran in 2012. The climate is characterized by mean annual precipitation of 245.75 mm, mean annual temperature of 10 ˚C, and mean annual maximum and minimum temperature of 16.6 ˚C and 4.2 ˚C, respectively. The experiment was factorial based on randomized complete block design with three replications. Factors were three levels of wheat straw application (control (0), 1.5 and 3 ton/ha) and five levels of burial depth of common cocklebur seed (3, 6, 10, 15 and 20 cm).

Experiment procedure

Corn seeds (370 double cross) were hand sown in 5 cm depth of soil. Each plot consisted of 4 rows of 4 m length, spaced 50 cm apart, oriented in a north-south direction. After seedling emergence, plants per unit area were reduced to 10 plants per m². The common cocklebur seeds were sown in both sides of the corn rows at density of 12 plants/m² at different soil depths including 3, 6, 10, 15 and 20 cm. All plots were irrigated after sowing and subsequent irrigations were applied at 7-days intervals. During growth season weed species other than cocklebur were removed by hand-hoeing.

Measurement of traits and statistical analysis

Chlorophyll content index was measured by portable chlorophyll meter (SPAD) in flowering stage. At flowering stage, the plants of 1 m² were harvested and leaf area index (Stoart and Doyer, 1998), plant height, leaf number and biomass were measured. Also, biomass of common cocklebur was determined. All the data were analysed on the bases of experimental design, using SAS 9.1 software. The means of each trait were compered according to Duncan multiple range test at p≤0.05.

Results

Analysis of variance of the data for corn growth showed that wheat straw application and burial depth of common cocklebur seed had significantly effect on leaf number, leaf area index and biomass were increased. Chlorophyll index was also in corn leaf significantly affected by application of wheat straw (Table1).

Table 1. Analysis of variance for growth characteristic of corn and biomass of common cocklebur under wheat straw application and burial depth of common cocklebur seed (ns, * and ** are no significant, significant at p≤0.05 and p≤0.01, respectively).

S.O.V	df	Plant height	Leaf number	Leaf area index	Chlorophyll content index	Biological yield	Common cocklebur biomass
Replication	2	574.821	0.706	0.398	0.568	37.19	5.823
Straw (S)	2	1954.313**	10.222**	2.906*	51.895*	1194.211**	129.153**
Depth (D)	4	4261.974**	14.351**	16.694**	2.857 ns	3833.173**	83.477**
S×D	8	661.173*	1.679ns	0.666 ns	11.216 ns	240.822 ns	18.187*
Error	28	247.138	0.922	0.716	10.72	121.111	6.542
CV%		10.65	12.35	16.79	11.38	13.78	11.58

Interaction of seed burial depth × wheat straw on plant height was significant. Plant height of corn with increasing burial depth of common cocklebur was significantly increased. Also, in all burial depth of seed, plant height was increased by increasing straw applications.As, 3 ton/ha application of wheat straw in 3, 6, 10 and 15 cm burial depth was higher that than of control and 1.5 ton/ha (Fig. 1).

Corn leaf number with increasing common cocklebur seed burial depth was significantly increased. Corn plants by beside of common cocklebur plant, which them obtainedfrom seeds thatburied in depth of 3 and 6 cm had the lowest number of leaf. In contrast, these plants by beside of common cocklebur plant that produced form seeds that buried in 15 and 20 cm had the maximum leaf number (Fig. 2a).

Wheat straw application also had significantly effect on corn leaf number. Maximum and minimum number of corn leaf was obtained from 3 ton/ ha straw and non-application of wheat straw (control), respectively (Figure 2b).

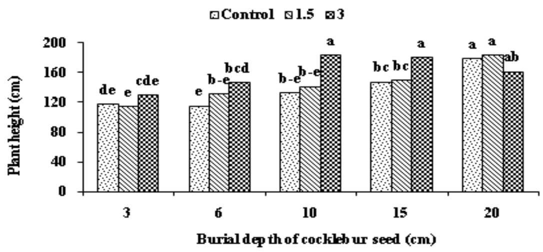

Fig. 1. Interaction effect of wheat straw application (control, 1.5 and 3 ton/ha) and common cocklebur seeds burial depth (3, 6, 10, 15 and 20 cm) on corn plant height (Different letters indicate significant difference at p≤ 0.05).

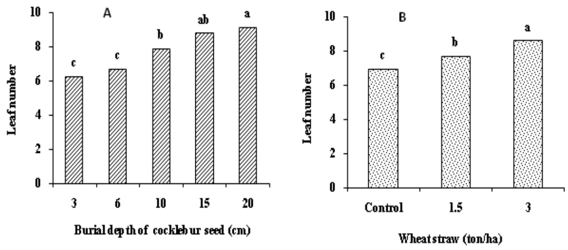

Fig. 2. The effect of burial depth of common cocklebur seed (3, 6, 10, 15 and 20 cm) (A) and different levels of wheat straw application (control, 1.5 and 3 ton/ha) (B) on leaf number of corn (Different letters indicate significant difference at p≤ 0.05).

Leaf area index of corn with increasing common cocklebur burial depth seeds was significantly increased. Corn plant in the neighboring of common cocklebur plant, which produced of seeds that buried in depths of 3 and 6 also in depths of 15 and 20 had the lowest and the most leaf area index (Figure 3A). Wheat straw application had significantly effect on leaf area index, as corn plant that growing in straw application of 3 ton/ha had the most leaf area index, in comparison to control and 1.5 ton/ha (Figure 3B).

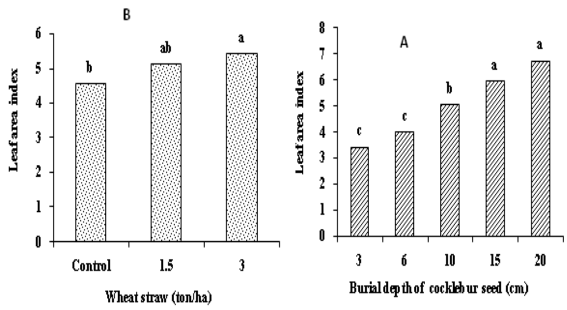

Fig. 3. The effect of burial depth of common cocklebur seed (3, 6, 10, 15 and 20 cm) (A) and different levels of wheat straw application (control, 1.5 and 3 ton/ha) (B) on leaf area index of corn (Different letters indicate significant difference at p≤ 0.05).

Chlorophyll content index was significantly affected by wheat straw application. Chlorophyll content index had the most of corn plant that produced under straw application of 3 ton/ha. Too, application of 1.5 ton/ha of wheat straw was led to that corn leaf had higher chlorophyll content in comparison to control (Figure 4).

Biomass of corn plant was significantly affected by wheat straw application and burial depth of seed. As, maximum biomass of corn plant in application of 3 ton/ha was obtained (Figure 5b). Also, corn plant that produced in condition that common cocklebur seed was buried in 15 and 20 depths of soil had the most biomass (Figure 5a). Biomass of corn plant in application of 1.5 ton/ha and control condition of straw, and also in 3 and 6 cm depths of seed buried were similar.

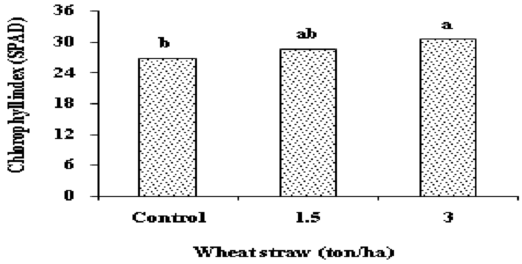

Fig. 4. The effect of different levels of wheat straw application (control, 1.5 and 3 ton/ha) on chlorophyll index of corn (Different letters indicate significant difference at p≤ 0.05).

Biomass of common cocklebur was affected by burial depth of seed and wheat straw application. Results showed that with increasing of burial depth of seed biomass of common cocklebur was declined. As, seed depth of 20 cm was caused that these of common cocklebur seed did not emerged. Also, increasing of straw application was caused that biomass of common cocklebur significantly reduced. With increasing burial depth of seed the effect of straw application was declined (Figure 6).

Discussion

Weeds are a main threat in maize production and common cocklebur is found as the most competitive weeds in corn (Royal *et al.*, 1997; Cavero *et al.*, 1999). As a result of common cocklebur less density may be competitive between corn and this weed was reduced. Thus, less competition can be effect on corn growth (Figures 1, 2, 3, 4 and 5). The plant height of maize was significantly altered by common cocklebur density as well (Figure 1). In a study of competition between *D. stramoium* and soybean, the major competitive impact was associated with the greater height of the weed (Stoller and Woolley, 1985). Saccol and Estefanel (1995) reported a reduction in crop leaf area, plant height, stem diameter, and leaf area index as a result of increased weed competition. The results were in line with those reported by David and Kovacs (2007) who stated that higher cocklebur density reduced maize plant height by 33% in weedy control plots compared to weed free plots.

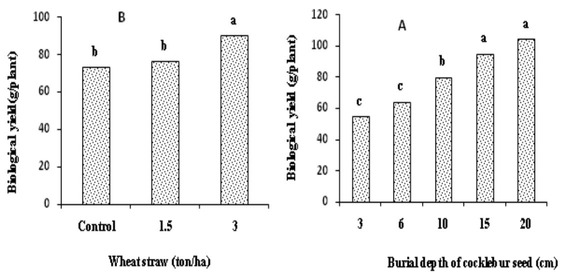

Fig. 5. The effect of burial depth of common cocklebur seed (3, 6, 10, 15 and 20 cm) (A) and different levels of wheat straw application (control, 1.5 and 3 ton/ha) (B) on biological yield of corn (Different letters indicate significant difference at p≤ 0.05).

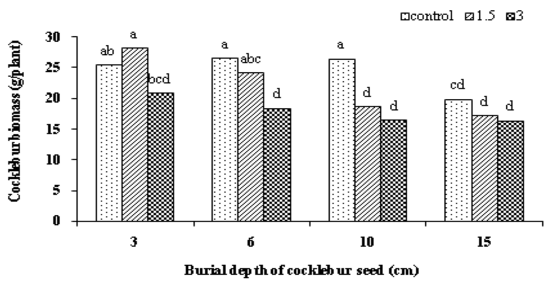

Fig. 6. Interaction effect of wheat straw application (control (0), 1.5 and 3 ton/ha) and common cocklebur seeds burial depth (3, 6, 10, 15 and 20 cm) on common cocklebur biomass per plant (Different letters indicate significant difference at p≤ 0.05).

Leaf area distribution in the canopy appeared to have distinct effects on light interception in crop mixtures such as sorghum/cowpea (Gilbert *et al.*, 2003), potato/maize (Mushagalusa *et al.*, 2008).Competition from the weed may reduce the LAI of corn (figure 3) that is similarly to Cavero *et al.* (1999) finding. Mosier and Oliver (1995) also showed that more reduction in total LAI of soybean by *X. strumarium* than *Ipomoea hederacea*. The common cocklebur density also had a significant (P≤0.05) effect on maize leaf area (Hussain *et al.*, 2012). Increasing the weed density significantly decreased maize leaf area with maximum reduction at common cocklebur density (Hussain *et al.*, 2012). The results confirmed that maize LAI was density dependent; increasing density of either species significantly altered the LAI. Tollenaar *et al.*, (1994) reported a significant effect of weed competition on maize LAI. Mishra (2000) reported that the chlorophyll status of both the crop and the weed decreased with increasing weed density.

Straw to soils are important because they are a major source of organic carbon and nutrients. Also, these materials can be effectively for crop growth and yield. As, in this study application of 3 ton/ha of wheat straw had significantly effect on plant height (Figure 1), leaf number (figure 2), LAI (figure 3), chlorophyll content index (Figure 4) and biomass (Figure 5). Common cocklebur density significantly decreased the biological yield of maize. Plant height was a key factor that contributed significantly to maize biological yield (Figure 5). By increasing the common cocklebur density, the biological yield of maize progressively decreased (Cavero *et al.*, 1999). Maize biomass was declined by increase in weed competition (Saayman and Van-de-Venter, 1997). Increased yield loss due to weed competition was associated with reduced plant height and light interception (Cavero *et al.*, 1999). No significant effects of straw application and burial depth of seed on 100 grain weight was indicated that grain number per row, cob and plant had the most effect of yield production. As a result of this research, less completion among weed and crop can be controlled by depth of weed seed. Also, wheat straw application is anappropriate way to weed control and improved yield of crops.

References

Adamtey N, Cofie O, Ofosu-Budu KG, Ofosu-Anim J, Laryea KB, Forster D. 2010. Effect of N-enriched co-compost on transpiration efficiency and water-use efficiency of maize (*Zea mays* L.) under controlled irrigation. Agricultural Water Management **97,** 995-1005. http://dx.doi.org/10.1016/j.agwat.2010.02.004

Afzal S, Din A, Awan MR. 1994. Preliminary studies on the distribution of maize weeds of Abbottabad and Haripur (NWFP). Pakistan Journal of Weed Science Research **7,** 13-17.

Amini R, Izadkhah S. 2013. Effect of seed position on parental plant on seed germination and seedling growth of common cocklebur (*Xanthium strumarium* L.). Journal of Biodiversity and Environmental Sciences **3,** 123-129.

Berzsenyi Z, Dang QL. 2007. Study of the effect of plant density on the growth of maize (*Zea mays* L.) hybrids using the Richards function. Acta Agronomica Hungarica **55,** 417-436.

Buhler DD. 1999. Weed population responses to weed control practices. I. seed bank, weed populations, and crop yields. Weed Science **47,** 416-422.

Byrd JD, Coble HD. 1991. Interference of common cocklebur *(Xanthium strumarium)* and cotton *(Gossypium hirsutum)*. Weed Technology **5**, 270-278.

Cavero J, Zaragoza C, Suso ML, Parado A. 1999. Competition between maize and *Datura stramonium*in an irrigated field under semi-arid conditions. Weed Research **39,** 225-240.

David I, Borbely VM, Radocz L. 2005. Changing of amounts of allelochemicals in Italian cocklebur (*X. italicum* Mor.) during the growing season**.** Novenyvedelem **41,** 397-403.

David I, Kovacs I. 2007. Competition of three noxious weeds with row crops. Cereal Research Communication **35,** 341-344.

Fu R, Ashley RA. 2006. Interference of large crabgrass (*Digitaria sanguinalis*), redroot pigweed (*Amaranthus retroflexus*) and hairy galinsoga (*Galinsoga ciliata*) with bell pepper. Weed Science **54,** 364-372. http://dx.doi.org/10.1614/WT-D-12-00174.1

Gilbert RA, Heilman JL, Juo ASR. 2003. Diurnal and seasonal light transmission to cowpea in sorghum–cowpea intercrops in Mali. Journal of Agronomy and Crop Science **189,** 21–39.

Hammad HM, Ahmad A, Azhar F, KhaliqT, Wajid A, Nasim W, Farhad W. 2011. Optimizing water and nitrogen requirement in maize (*Zea mays* L.) under semi-arid conditions of Pakistan. Pakistan Journal of Botany **43,** 2919-2923.

Hussain Z, Marwat KB, Cardina J. 2011. Common cocklebur competition in forage maize. Weed Technology **25,** 151-158.

Hussain Z, Marwat KB, Gul B, Saeed M, Bibi S. 2012. Effect of common cocklebur density on biological yield of maize at varying populations. Pakistan Journal of Botany **44,** 1627-1632.

Li SX, Wang ZH, Li SQ, GaoYJ, Tian XH. 2013. Effect of plastic sheet mulch, wheat straw mulch, and maize growth on water loss by evaporation in dry land areas of China. Agricultural Water Management **116,** 39–49. http://dx.doi.org/10.1016/j.agwat.2012.10.004

Marwat KB, Nafziger ED. 1990. Cocklebur and velvetleaf interference with soybean grown at different densities and planting patterns. Agronomy Journal **82,** 531-534.

Mishra GN. 2000. Crop weed competition under varying densities of jungle rice (*Echinochloa colona*) in upland rice. Indian Journal of Agricultural Science **70(4),** 215-217.

Mosier DG, Oliver LR. 1995. Common cocklebur (*Xanthium strumarium*) and entire leaf morningglory (*Ipomoea hederacea* var.

integriuscula) interference on soybean (*Glycine max*). Weed Science **43,** 239-246.

Mushagalusa GN, Ledent JF, Draye X. 2008. Shoot and root competition in potato/maize intercropping: Effects on growth and yield. Environment Experimental Botany **64,** 180–188.

Oljaca S, Vrbnicanin S, Simic M, Stefanovic L, Dolijanovic Z. 2007. Jimsonweed (*Daturastramonium*L.) interference in maize. Maydica **52(3),** 329-333.

Randhawa MA. 1995. Effect of plant spacing and weeds infestation on different agro-physiological traits of maize. Ph. D Thesis. University of Agriculture, Faisalabad-Pakistan.

Royal SS, Brecke BJ, Calvin DL. 1997. Common cocklebur (*X. strumarium*) interference with peanut (*Arachis hypogaea*). Weed Science **45,** 38-43.

Saccol AV, Estefanel V. 1995. Competition between barnyard grass and soybean cultivated in hydromorphic soil: Effect on some agronomic characteristics. Pesquisa Agropecuaria Brasileira **30**, 327-338.

Shah A, Gohar R, Khalid S, Akmal M. 2011. Seminal root of maize varieties in relation to reduction in the substrate moisture content. Pakistan Journal of Botany **43,** 2897-2902.

Shamayeli M. 2012. Advantage of two and three species intercropping of sunflower, maize and soybean. Msc. Thesis. Faculty of Agriculture. University of Tabriz. Iran.

Stoller EW, Woolley JT. 1985. Competition for light by broadleaf weeds in Soybean (*Glycine max*). Weed Science **33,** 199-200.

Tollenaar M, Dibo AA, Aguilara A, Weise SF, Swanton CJ. 1994. Effect of crop density on weed interference in maize. Agronomy Journal **86,** 591-595.

Wicks GA, Crutchfield DA, Burnside OC. 1994. Influence of wheat (*Triticum aestivum*) straw mulch and metolachlor on corn (*Zea mays*) growth and yield. Weed Science **42,** 141-147.