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COMPETITIVE INDICES OF *Echinochloa crusgalli* AND MAIZE UNDER AGRO-ECOLOGICAL CONDITIONS OF DERA ISMAIL KHAN, PAKISTAN

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ABSTRACT

To investigate the competitive indices and yield losses due to Echinochloa crusgalli in maize, an experiment was carried out during summer 2013 at Agriculture Research Institute (ARI) Dera Ismail Khan, Pakistan. The trial was conducted in RCB design replicated thrice, comprising eight treatments viz, maize + E. crusgalli 0 plants, maize + E. crusgalli 75 plants, maize + E. crusgalli 150 plants, maize + E. crusgalli 225 plants, maize + E. crusgalli 300 plants, maize + E. crusgalli 375 plants, maize + E. crusgalli 450 plants and E. crusgalli pure stand (600 plants). The data recorded in different plots were compared with control plot. Plant height (cm), stem girth (cm), number of grains cob^{-1}, 1000-grain weight (g), biological yield (t ha^{-1}) and grain yield (t ha^{-1}) of maize significantly (P≤0.01) differed. The highest grain yield and biological yield was observed in control (no competition) whereas minimum in the plot having 450 E. crusgalli plants. Similarly other parameters also decreased significantly with increased densities of E. crusgalli.

Key words: Maize, *Echinochloa crusgalli*, competition, weeds, yields.

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INTRODUCTION

After wheat and rice, maize is considered to be the most important crop in the world. It has the potential to respond to various agronomic practices. Among other factors of low yield in maize crop, improper fertilizer use, low planting density, traditional methods of sowing, lack of proper weeds management etc are the factors of prime importance. Maize has high genetic potential and high photo-synthetic

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efficiency. In Pakistan, it covered an area of 935,000 hectares with grain production of 3262,000 tons (Anonymous, 2010).

Maize has a great promise of higher yield and easy cultivation than any other cereal crop and if managed properly, can go a long way in increasing food production in our country. But unfortunately, in spite of its great yield potentials, the average production in country is still very low in comparison to other important maize produucing countries. To obtain better grain yield, it is essential to maintain optimum number of plants ha^{-1} because it is an important factor for controlling weeds and increasing yield. Weeds have competetive ability for nutrients, moisture, space, and light and cause predominantly reduction in the yield and the quality (Hussain, 1983).

Weeds compete with crop plants for different resources like light, water, nutrients etc. Annual weeds compete most effectively with maize during the seedling stages and early stages. Various weed management options have been employed in past that address weed management without threshold level of individual weed. The underlining reason is that weed flora in maize and their competitive abilities differ with changes in environment even at micro-climate level, which is again under the influence of crop canopy (light interception). Thus, it is desired to find the competition indices of major weed of maize for agro-climatic conditions of Dera Ismail Khan. Crop weed competition is always dependent on the density of each species (Khan and Marwat, 2006). Differences in canopy architecture play an important role against weeds in cereals (Olesen *et al*., 2006).

Keeping in view the importance of maize and weeds, there is need to study this aspect of weed science that looks towards maintaining profitability of farming operation and alertness of the farmers about the ill effects of *Echinochloa crusgalli*. Such studies will facilitate the scientists and farmers in decision making processes of weed management. The instant designed study was thus to determine the response of maize and *Echinochloa crusgalli* to various densities with the objectives to figure out yield losses due to *Echinochloa crusgalli* in maize and to find out competition indices and threshold level of *Echinochloa crusgalli* in maize.

MATERIALS AND METHODS

A study on competitive effects of *Echinochloa crusgalli* and maize under agro-ecological conditions of D.I. Khan was carried out at Agricultural Research Institute (ARI), D.I. Khan in summer season 2013. The experiment was conducted in RCB design with 3 replications with a plot size of 5m × 3m ($15m^2$) having three rows. Maize variety "Azam" was sown in mid July by dibbling method using seed rate of 25 kg ha^{-1} in rows 75 cm apart. The plant to plant distance was kept 25

cm. The experiment consisted of eight treatments in which the density of *Echinochloa crusgalli* varied (0, 75, 150, 225, 300, 375 and 450 plants/15 m^2) including *Echinochloa crusgalli* in pure stand (600 plants), while the maize density was kept constant (20 plants m^{-2}). Fertilizer at the rate 120: 80: 60 kg ha^{-1} NPK was used. All the phosphorus and potash along with half nitrogen were applied at sowing while the rest of nitrogen was added in two doses. All the cultural operations were kept normal and uniform.

Data collection and analysis

The variables evaluated were plant height (cm), stem girth (cm), number of grains cob^{-1}, 1000-grain weight (g), biological yield (t ha^{-1}) and grain yield (t ha^{-1}) of maize. Regression analysis was performed for all the recorded parameters. The purpose of regression analysis was to find out the linear competitive response of maize with *Echinochloa crusgalli*. For this purpose Microsoft Excel 2007 was used.

RESULTS AND DISCUSSION

Plant height (cm)

Data regarding plant height is given in Fig. 1(a) whereas its regression analysis is given in Table-1. Regression analysis depicted that highly significant ($p \leq 0.0261$) decrease in plant height was found with increasing density of *E. crusgalli*. The decreasing trend was linear and the height of maize gradually decreased with increasing population of *E. crusgalli*. Maximum plant height was recorded in the control plot (135.09 cm) where no *E. crusgalli* plants was cultivated while minimum plant height was recorded in 450 *E. crusgalli* plants (98.1cm) in competition with maize. All the other treatments were intermediate between control and the block having 450 *E. crusgalli* plants. In previous research Coleman and Gill (2005) also reported that biological and grain yield losses increases due to competition which is associated with reduced plant height.

Stem girth (cm)

The regression analysis of stem girth of maize as affected by various *E. crusgalli* population is presented in Table-1.whereas mean values are given in Fig. 1(b). Highly significantly ($P \leq 0.0006$) differences were observed among various treatments (Table-1) for maize stem girth. Fig. 1(b) depicted a gradual linear decreasing trend with increased population of *E. crusgalli.* Thus, maximum stem girth (2.94 cm) was found in the treatment having 0 plants of *E. crusgalli* whereas minimum stem girth (1.12 cm) was recorded in the block having 450 plants of *E. crusgalli* which was statistically at par with the treatment having 375 plants of *E. crusgalli* (1.23). This gradual decrease in the stem girth might be attributed to the increased competition of *E. crusgalli* for nutrients, water, light, etc.

Number of grains cob^{-1}

The effect of various *E. crusgalli* densities on number of grains is given in Fig. 1 and Table-1. Highly significant ($p \leq 0.0142$) decrease in grains per cob was found with increase in density of *E. crusgalli* plants. The decreasing trend in grains per cob was linear and thus number of grains decreased gradually with an increase in the population of *E. crusgalli*. Maximum number of grains (440) were observed in control plot where no competition was found with *E. crusgalli* plants while minimum number of grains (305) were noted in plot infested with 450 *E. crusgalli* plants where the competition for nutrients and other resources was maximum. Anafjeh and Chaab (2012) also found decreased number of grains/cob with increased weed competition.

Thousand grain weight (g)

Data regarding thousand grain weight of maize is shown in Fig. 3(b) whereas its regression analysis is given in Table-1. Highly significant ($P \leq 0.0049$) decrease in 1000-grain weight was found with increased density of *E. crusgalli* plants. Data in Fig. 1d exhibit that with increase in *Echinochloa crusgalli* population linear decrease in 1000-grain weight was found. Minimum 1000 grain weight was noted in plot with 450 *E. crusgalli* plants (150 g) while heavier grains were recorded in control plot (250 g). This decreasing trend might be due to competitive effect for nutrients, water, light etc. Khan *et al*. (2007) also found similar competitive effect for 1000 grain weight in wheat with various densities of oat plants.

Biological yield (t ha^{-1})

The total biomass per hectare expresses the overall growth and developmental potential of a crop. Two central rows of maize were harvested and bundled in each treatment at physiological maturity. The bundles then weighed into t ha^{-1}. Biological yield of maize is presented in Fig. 2(a) and its regression analysis is given in Table-1**.** Regression analysis depicted that biological yield was highly significantly ($p \leq 0.026$) reduced by the *E. crusgalli plant* densities. Maximum biological yield was recorded in control plot (23.6 t ha^{1}) while minimum was observed in highest *E. crusgalli* plant density i.e. with 450 plants (11.44 t ha^{1}) which was statistically at par with the treatment having 375 plants of *E. crusgalli*. Armin *et al.* (2007) reported that increasing weed densities creates dwindling effect on biological yield. They reported that with increase in oat density the wheat biological yield reduces.

Grain yield (t ha^{-1})

Mean values regarding grain yield are presented in Fig. 2(b) which clearly depicted that highly significant ($p \leq 0.0013$) differences were observed in different treatments for grain yield. Gradual decrease

in grain yield was found with increased density of *E. crusgalli* plants. Maximum grain yield (2.7 t ha^{1}) was obtained in control followed by block having 75 *E. crusgalli* plants whereas minimum grain yield i.e. (1.4 t ha^{1}) was recorded in the treatment with 450 *E. crusgalli* plants. The reduction in maize yield due to increasing competition of maize with *E. crusgalli* was considerably higher which might be attributed to its competitive effect and capturing resources from maize crop. In a competition studies, Khan *et al.* (2013) reported that weed infestation caused failure of maize crop due to negligible grain yield.

Leaf area index (LAI)

Data pertaining to leaf area index are presented in Fig. 3(a) whereas its regression analysis is given in Table-1. Highly significant ($P \leq 0.03$) decrease in leaf area index was found with increased density of *E. crusgalli* plants. Data in figure 9a exhibit that with increase in *E. crusgalli* population a linear decrease in leaf area index was found. Minimum leaf area index was noted in plot with 450 *E. crusgalli* plants (0.55 cm) while maximum leaf area was recorded in control plot (1.46 cm). This decreasing trend might be due to competitive effect for nutrients, water, light etc.

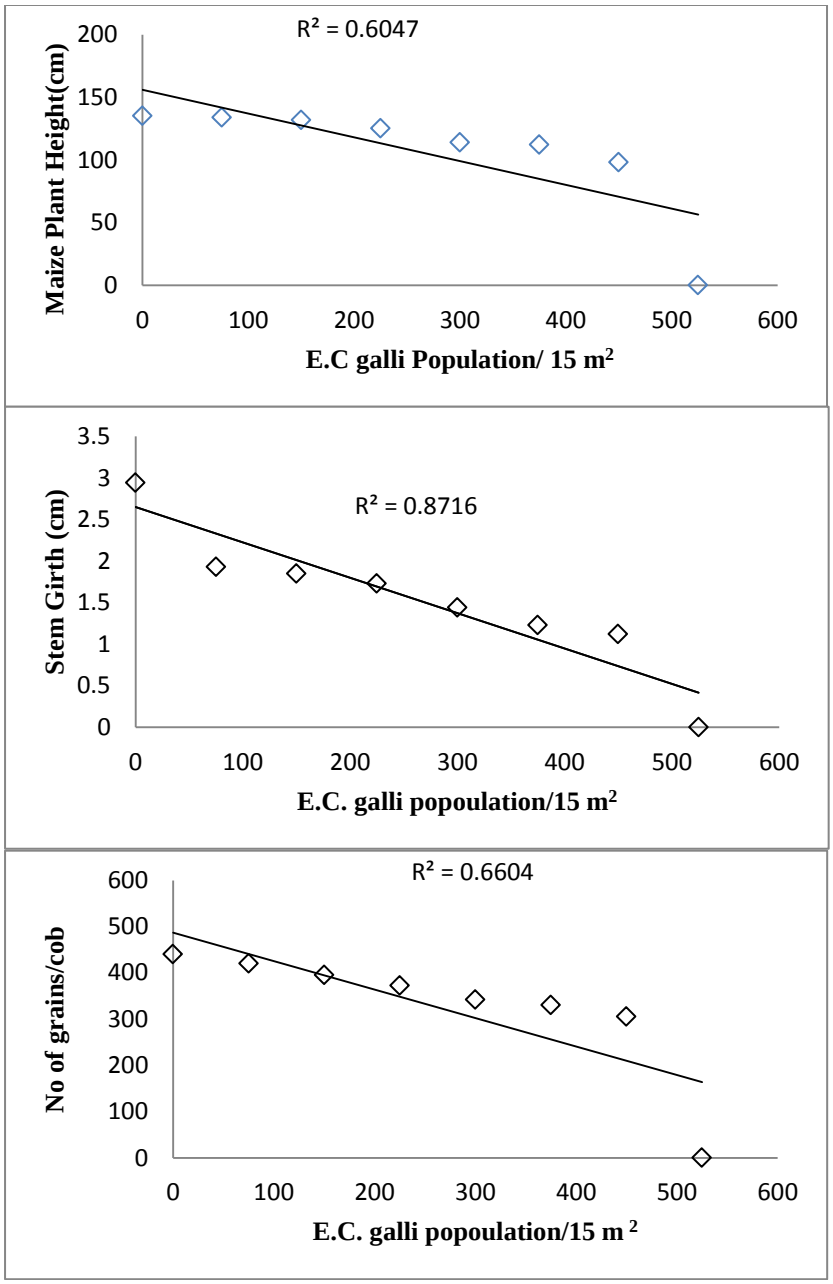

Figure 1. (a) Plant height, (b) stem girth, and (c) no of grains cob^{-1} of maize as influenced by various populations of *Echinochloa crusgalli.*

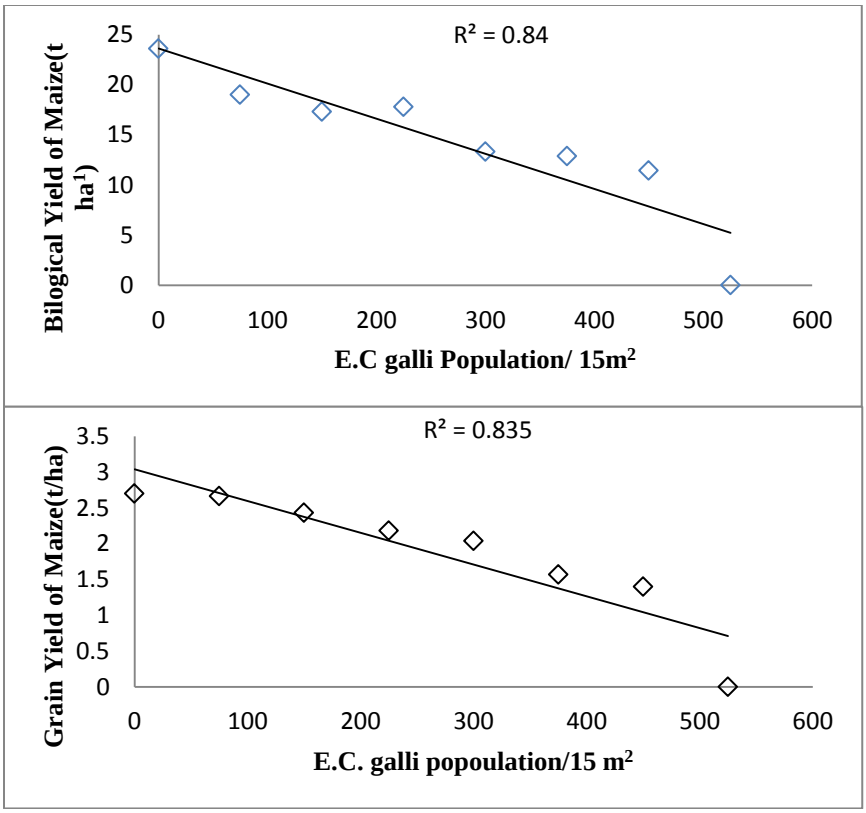

Figure 2. (a) biological yield and (b) grain yield of maize as influenced by various populations of *Echinochloa Crusgalli*

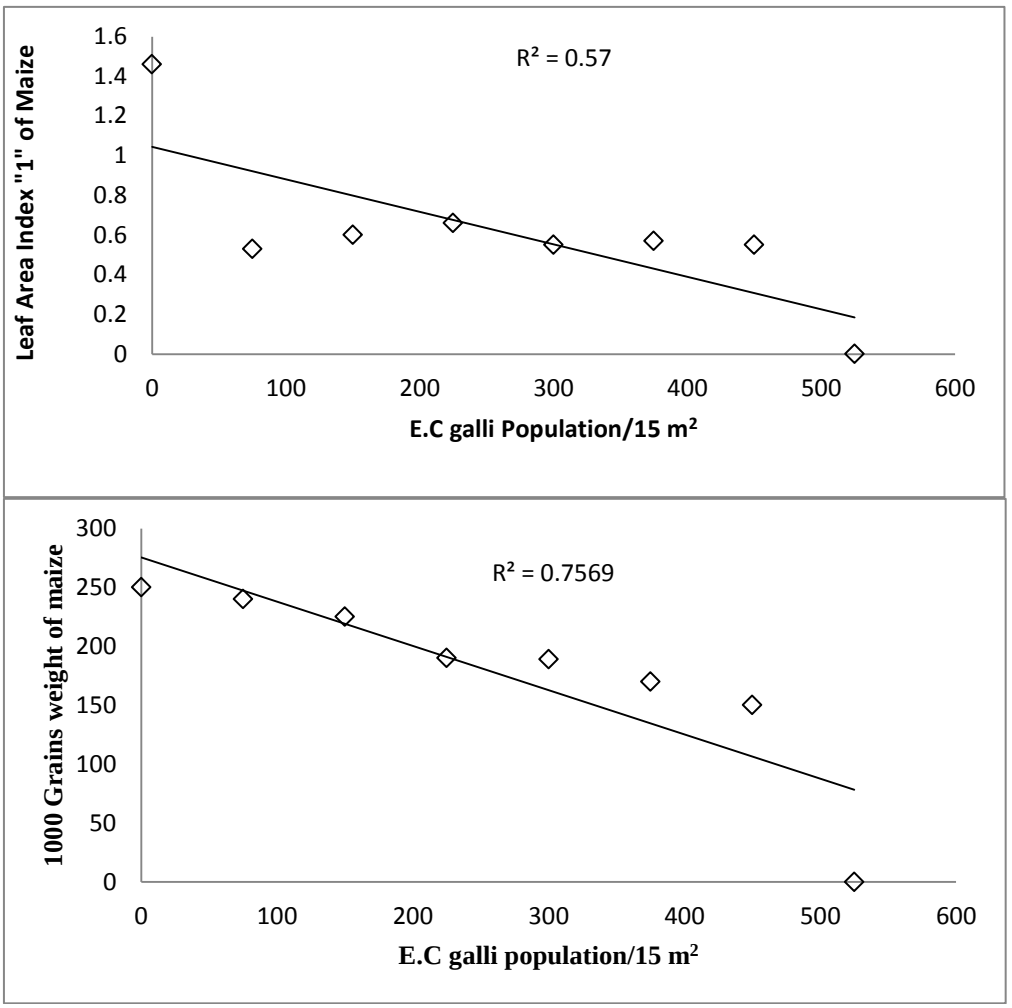

Figure 3. (a) Leaf Area Index and (b) 1000 grain weight of maize as influenced by various populations of *Echinochloa crusgalli*

Table-1. Regression analysis of various maize parameters studied.

PARAMETERS	A	B	R^2	Probability
Maize plant height (cm)	24.721±8.56	-0.189± 0.062	0.589	0.026
Stem girth 0f maize (cm)	2.645± 0.208	-0.043± 0.006	0.871	0.0006
Numbers of grains/cob	487.16±56.57	-0.615± 0.018	0.66	0.0142
1000 grains weight (gm)	275.3±27.25	-0.375± 0.086	0.756	0.0049
Biological yield (t/ha)	22.14±2.23	-0.0299±0.007	0.747	0.0056
Maize grain yield (t/ha)	3.0394±0.25	-0.00443±0.0008	0.834	0.0013
Leaf area index of maize	1.045±0.18	-0.00163±0.0008	0.57	0.03

CONCLUSION

The grain and biological yields of maize were highest in control plots where no competition was there throughout the season. These values were minimum in the plots infested with 450 *E. crusgalli* plants. In the same way the rest of the parameters were decreased significantly with increasing the density of *E. crusgalli*.

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