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INTERFERENCE OF HORSE PURSLANE (*TRIANTHEMA PORTULACASTRUM* L.) WITH MAIZE (*ZEA MAYS* L.) AT DIFFERENT DENSITIES

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Abstract

To quantify the impact of horse purslane (*Trianthema portulacastrum*) on the yield and yield components of maize, experiments were conducted at Agricultural Research Farm, NWFP Agricultural University Peshawar, Pakistan for two crop seasons viz., 2006 and 2007, using open pollinated variety 'Azam'. The experiments were laid out in Randomized Complete Block (RCB) design with split plot arrangements having three replications. Four maize plant spacings (15, 20, 25 and 30 cm) were kept in main plots, while weed densities (3, 6, 9, 12, 15 and 18 m^{-2}) were allotted to sub plots. Narrow plant spacing of 15 cm produced higher grain yield of 2.85 and 2.66 t ha^{-1} as compared to 2.30 and 2.08 t ha^{-1} in wider plant spacing of 30 cm during 2006 and 2007, respectively. However, during both years, yield components of individual plants were negatively affected with a decrease in plant spacing. Similarly, control plots produced higher grain yield of 3.04 and 2.87 t ha^{-1}as compared to grain yield of 2.14 and 2.0 t ha^{-1} in plots having weed density of 18 plants m^{-2} in 2006 and 2007, respectively. Losses due to *T. portulacastrum* were 4.2, 11.1, 18.6, 20.4, 27.2 and 29.5% during 2006 and 9.3, 14.3, 18.3, 23.2, 25.1 and 30.2% during 2007 in plots having 3, 6, 9, 12, 15 and 18 weeds m^{-2}. Two years research showed that narrow spacing enhanced competitive ability of maize crop and suppressed weed growth, which eventually resulted in higher yield, depicting that *T. portulacastrum* is a strong competitor of maize and may cause substantial yield losses depending on plant spacing and weed density. Moreover, plant spacing alone is not effective to suppress *T. portulacastrum*; therefore, other cultural practices should also be integrated with narrow spacing to reduce yield losses in maize crop.

Introduction

Agriculture being the backbone of Pakistan's economy, employs 50% of the total labor force at national level, contributing 25 and 85% to GDP and export earnings, respectively. Maize (*Zea mays* L.) is a popular food, feed and fodder crop in Pakistan. Maize yield in Pakistan is only 3.0 t ha^{-1} compared to USA 8.92 t ha^{-1}, Canada 7.82 t ha^{-1}, France 7.14 t ha^{-1} and China 4.85 t ha^{-1} (Anon., 2003). There is always a competition for resources amongst crop and weeds which are mostly won by weeds as they are better adapted to different agro-ecological environments. Weeds compete with crop for space, sunlight, moisture and nutrients thus decrease the crop yield. Competiveness of the crop is affected by plant spacing, leaf size, plant height and time of emergence (Hamayun, 2003). Weed competitiveness is dependent on weed species density and duration. The season-long weed competition caused considerable yield losses in maize (Dalley *et al*., 2006). In NWFP, the losses due to weeds in maize are about 20-40% (Anon., 2005). In another study weeds are reportedly capable of reducing corn grain yield by 35-70% if not managed (Ford & Pleasant, 1994) and uncontrolled weed growth brings about 83% decline in average grain yield of maize (Usman *et al*., 2001). Horse purslane (*Trianthema portulacastrum* L.) is a common weed of maize, cotton and vegetables all over Pakistan (Hashim & Marwat, 2002). It is found as a major weed in maize, cotton, potato, sugarcane, and summer vegetables blooming from May-October in Pakistan. Due to indeterminate habit, vegetative and reproductive growth continues for the entire life span

(Nayyar *et al*., 2001). Keeping in view the economic importance of horse purslane in summer crop of Pakistan an experiment was laid out in Randomized Complete Block (RCB) design with a split plot arrangements with these objectives (1) to find out the appropriate plant spacing of maize crop for suppression of *T. portulacastrum* and (2) to evaluate the yield losses due to *T. portulacastrum* in maize.

Materials and Methods

An experiment was laid out in Randomized Complete Block (RCB) design with a split plot arrangements at Agricultural Research Farm, NWFP Agricultural University, Peshawar in 2006 and 2007. Four plant spacings (15, 20, 25 and 30 cm) were allotted to main plots while horse purslane densities (3, 6, 9, 12, 15 and 18 m^{-2}) were assigned to sub plots. Maize variety 'Azam' and *T. portulacastrum* were planted on a well prepared seed bed. All other weeds were removed manually throughout the growing season. A basal dose of 150 kg N and 60 kg P was applied in the form of urea and single super phosphate. Irrigation was applied according to the need of the crop. Harvesting of the crop was done manually.

During the course of studies data were recorded on 1000-kernel weight (g), grain yield (t ha^{-1}) harvest index (%) and percent yield losses in maize due to *T. portulacastrum.* For recording grain yield data central two rows were harvested, sun dried, shelled and subsequently converted into t ha^{-}1. Combined analyses were carried out for each parameter for the two years data, using the ANOVA procedure. The years' effect was significant; therefore, separate analyses were performed for each year. The significant means were separated by using Least Significant Difference test (Steel & Torrie, 1980). Since the level of treatments was quantitative, spaced at equal intervals therefore, regression analyses were also carried out to determine the trends for the relevant parameters.

Results and Discussion

1000-kernel weight (g): Effect of plant spacing and *T. portulacastrum* density for 1000-kernel weight of maize was significant, while their interaction was not significant during both years. Higher 1000-kernel weight of 194.8 and 189.5 g was recorded in wider plant spacing of 30 cm compared to lower1000-kernel weight of 188.3 and 178.4 g in narrow plant spacing of 15 cm during 2006 and 2007, respectively (Table 1). Higher kernel weight in wider plant spacing may be due to larger space, lesser competition and better utilization of growth resources (Waqar, 2002). Kernel weight declined at high plant population as compared to low plant population (Bavec & Bavec, 2002; Tyagi *et al*., 1998)). Higher 1000-kernel weight of 201.1 and 194.6 g was recorded in control plots compared to lower 1000-kernel weight of 183.4 and 173.8 g in plots having higher weed density of 18 plants m^{-2} during 2006 and 2007, respectively (Table 1). The yield and yield components were strongly influenced by the presence of *Solanum elaeagnifolium* (Baye & Bouhache, 2007; Williams & Masiunas, 2006). Lower weed density of 3 plants m^{-2} did not reduce 1000-kernel weight; however, higher density affected 1000-kernel weight due to both intra as well as interspecific competition. Regression analysis showed that 1000-kernel weight decreased linearly by increasing weed density in all plant spacings (Fig. 1a & b).

'able 1. Effect of maize plant spacing and *Trianthema portulacastrum* densities on some agronomic traits of maize in 2006 and 2007.

	1000-kernel weight (g)		Grain yield (t ha^{-1})		Harvest index (%)		Yield losses (%)	
	2006	**2007**	**2006**	**2007**	**2006**	**2007**	**2006**	**2007**
Plant spacing (S) (cm)								
15	188.3 c	178.4 c	2.85 a	2.66 a	40.98	39.70 a	16.8	18.7
20	190.9 b	182.1 bc	2.68 a	2.53 a	40.66	38.76 ab	18.6	20.4
25	192.1 b	185.0 b	2.42 b	2.25 b	38.61	36.58 bc	19.1	20.3
30	194.8 a	189.5 a	2.30 b	2.08 c	38.83	35.58 c	19.5	20.9
$LSD_{(0.05)}$	2.06	4.14	0.17	0.15	NS	2.29	-----	-----
T. portulacastrum density (D) (m^{-2})								
0	201.1 a	194.6 a	3.04 a	2.87 a	41.89 a	40.56 a	-----	-----
3	196.6 ab	189.6 ab	2.92 b	2.60 b	41.98 a	38.65 ab	4.2	9.3
6	192.9 bc	186.6 bc	2.71 c	2.47 c	40.77 ab	38.61 abc	11.1	14.3
9	191.1 bcd	184.0 bcd	2.48 d	2.35 d	39.56 abc	37.32 bcd	18.6	18.3
12	188.7 bcd	180.7 cde	2.43 d	2.21 e	39.08 bc	36.66 cd	20.4	23.2
15	186.9 cd	177.0 de	2.21 e	2.16 e	38.15 bc	36.31 d	27.2	25.1
18	183.4 c	173.8 e	2.14 e	2.00 f	36.97 c	35.49 d	29.5	30.2
$LSD_{(0.05)}$	8.16	7.56	0.11	0.08	2.68	1.97	-----	-----
Interaction (S x D)	NS	NS	*	*	NS	NS	-----	-----

eans of the same category followed by different letters are significantly different at $p \le 0.05$ level using LSD test.

= Maize plant spacing, D = *T. portulacastrum* density

; = Non-significant, * = Significant at $p \le 0.05$

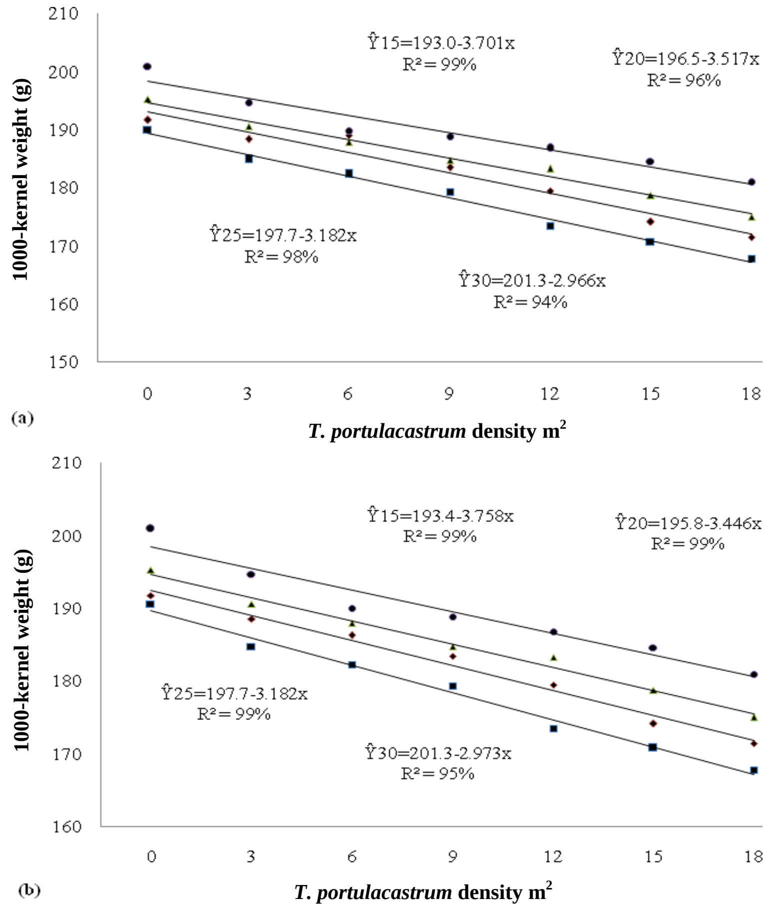

Fig. 1. Interactive effect of plant spacing and *T. portulacastrum* density on 1000-kernel weight (g) during 2006 (a) and 2007 (b) (■ = 15, ♦ = 20, ▲= 25, ● = 30 cm).

Grain yield (t ha^{-1}): Effect of plant spacing, *T. portulacastrum* density and their interaction on grain yield was significant during the two experiments conducted in 2006 and 2007. Higher grain yield of 2.85 and 2.66 t ha^{-1} was recorded in narrow plant spacing compared to lower grain yield of 2.30 and 2.08 t ha^{-1} in wider plant spacing during 2006 and 2007, respectively (Table 1). The higher grain yield at narrow plant spacing may be due to presence of more number of plants m^{-2}. Our results are in agreement with the work of Bruns & Abbas (2003), who reported that maize grain yield increased with increasing plant density with no yield plateau or decline observed at the higher population. Higher grain yield of 3.04 and 2.87 t ha^{-1} was recorded in check plots compared to lower grain yield of 2.14 and 2.0 t ha^{-1} in plots having high weed density of 18 plants m^{-2} (Table 1). The decrease in yield with increasing weed density was likely due to interspecific competition for resources (Baye & Bouhache, 2007; Williams & Masiunas, 2006). The trend lines show that grain yield decreased linearly in all plant spacings with increasing weed densities (Fig. 2a & b).

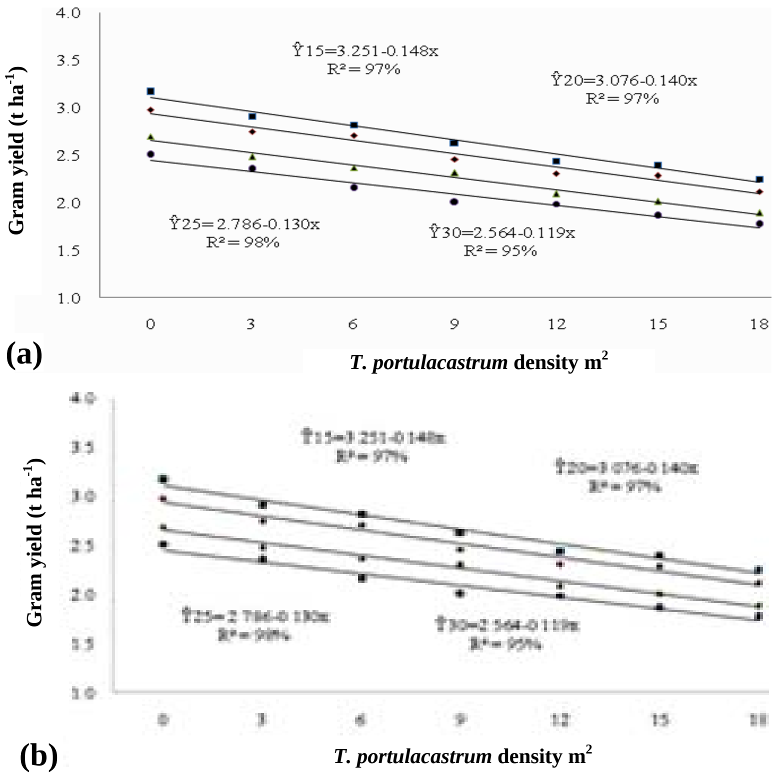

Fig. 2. Interactive effect of plant spacing and *T. portulacastrum* density on grain yield (t ha^{-1}) during 2006 (a) and 2007 (b) (■ = 15, ♦ = 20, ▲= 25, ● = 30 cm).

Harvest index (%): Effect of plant spacing on harvest index was not significant during 2006, but it was significant during 2007. Higher harvest indices of 40.98 and 39.70% were recorded in narrow plant spacing compared to lower harvest indices of 38.83 and 35.58% in wider plant spacing in 2006 and 2007, respectively (Table 1). Our results are in close agreement with the work of Waqar (2002), who reported that harvest index increased with decrease in plant spacing of maize. The effect of *T. portulacastrum* density on harvest index was significant and higher harvest indices of 41.89 and 40.56% were recorded in control plots compared to lower harvest indices of 36.97 and 35.49% in plots having the higher weed density of 18 plants m^{-2} in 2006 and 2007, respectively (Table 1). According to Tessema & Tanner (1997) harvest index depends upon the weed species and density. Weed competition reduced harvest index (Pageau & Trembla, 1996). The regression analysis show that harvest index decreased quadratically with increase in weed density across all plant spacings except 30 cm plant spacing which showed linear trend in 2006 (Fig. 3a & b). The decreasing trend in harvest index due to weed density showed that *T. portulacastrum* affected grain yield more compared to vegetative biomass. Similar results were reported by Tollenaar *et al*., (1994), who measured a decline in harvest index was due to weed interference.

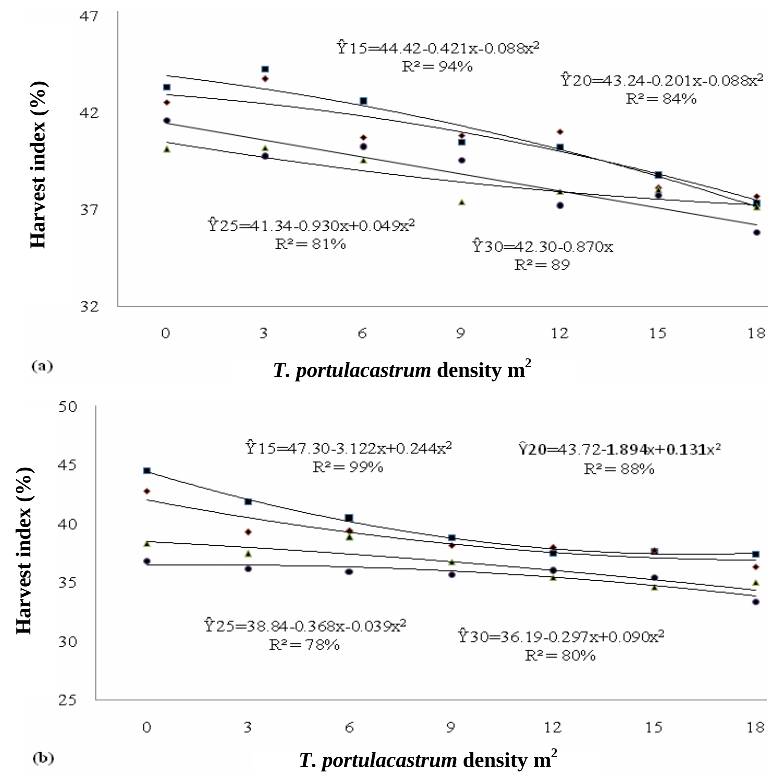

Fig. 3. Interactive effect of plant spacing and *T. portulacastrum* density on harvest index (%) during 2006 (a) and 2007 (b) (■ = 15, ♦ = 20, ▲= 25, ● = 30 cm).

Percent yield losses in maize due to *T. portulacastrum*: During both years lower yield losses due to weed competition were 16.8 and 18.7% in 15 cm plant spacing compared to maximum yield losses of 19.5 and 20.9% in 30 cm plant spacing during 2006 and 2007, respectively (Table 1). Our findings depict that maize plants at narrow plant spacing can efficiently compete with *T. portulacastrum* and suppress this weed hence yield losses are minimized. Higher yield losses of 29.5 and 30.2% were recorded in plots having higher weed density of 18 plants m^{-2} compared to lower losses of 4.2 and 9.3% in plots having lower weed density of 3 plants m^{-2} (Table 1). It is evident from the data that *T. portulacastrum* is harmful to maize and needs to be managed as early as possible.

Conclusion and recommendations: All densities of *T. portulacastrum* were effective in reducing yield. Plant spacing of 15 cm was much suitable for maize crop, for competition with *T. portulacastrum* more effectively. Higher grain yield (2.85 and 2.66 t ha^{-1}) was obtained from 15 cm plant spacing followed by 20 cm plant spacing (2.68 and 2.53 t ha^{-1}) in 2006 and 2007, respectively. Even a single plant of *T. portulacastrum* m^{-2} is detrimental to yield, therefore it should be treated as noxious weed. In the prevailing situations, 15 cm plant spacing should be adopted by the maize growing farmers. Manipulation of plant spacing alone was not enough to combat *T. portulacastrum*, hence other management tactics should also be applied for achieving better yield.

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