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Horse Purslane (*Trianthema portulacastrum* L.) Interference on Mungbean (*Vigna radiata* L.)

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ABSTRACT

A field study was conducted to evaluate the effect of horse purslane on mungbean productivity at the research farm of MNS-University of Agriculture Multan during Kharif season of 2018. For this purpose, 10 experimental treatments including T_1 (weed free for the whole season), T_2 (horse purslane free for 20 days after emergence, DAE), T_3 (horse purslane free for 40 DAE), T_4 (horse purslane free for 60 DAE), T_5 (all weeds free for 20 DAE), T_6 (all weeds free for 40 DAE), T_7 (all weeds free for 60 DAE), T_8 (weedy check with all weeds), T_9 (weedy check except horse purslane) and T_{10} (weedy check containing only horse purslane) were used. The experiment was carried out under RCBD (Randomized complete block design) and replicated thrice. Data was recorded for different growth and yield related traits of mungbean by using standard procedures. Data recorded were statistically analyzed and treatment means were compared by using Tuckey's test @ 5% probability level. Results showed that maximum number of grains per pod (10.66), number of pods plant^{-1} (28.00), 1000 grain weight (68.40 g), grain yield (1.9 t ha^{-1}) were noticed in the plots which were kept weed free. Hence it may be concluded that for maximum yield, farmers should control horse purslane at early stage of the crop.

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INTRODUCTION

Mungbean (*Vigna radiata* L) is one of the most important grain legume crops belongs to Fabaceae family. Mungbean is usually grown for edible seeds as its seeds contain 22-25% protein and also contains antioxidants and considerable quantity of fiber. Mungbean can also fix atmospheric nitrogen with the help nitrogen fixing bacteria and add 30-251 kg ha^{-1} nitrogen in the soil (Hoorman *et al*., 2009). In Pakistan, mash been, pigeon pea and mungbean are grown as summer legumes (Nusrat *et al*., 2014). In South Asia, pulses are the important source of iron, micronutrients, proteins and it is a diet of the poor people (Nair *et al*., 2013). Its total area under cultivation was 231.1 thousand ha with production of 204.5 thousand tonnes and it was 62.4% higher than the last year. Total production of mungbean

in Punjab was up to 85% and 88% of the total area (NARC, 2016). In South and South East Asia, many people are vegetarians; mungbean provides protein for millions of people (Keatinge *et al*., 2011).

Horse purslane *(Trianthema portulacastrum)* is harmful weed in many tropical and sub-tropical countries (Mubeen *et al*., 2011). *Trianthema portulacastrum* has negative allelopathic effects on plant height, number of pods and number of grains (Umarani and Selvaraj, 1995). It also affects the production of soybean. Horse purslane forms a green carpet on the top of soil because it has higher branching capacity and flat growth (Senthil *et al*., 2009). In Pakistan, horse purslane proliferates from April to October, and it produces small white flowers 20-30 DAE. A mature horse purslane produces fruits per plant as many as 3,330 and each fruit contains 6-10 seeds (Galinato *et al*., 1999). In summer crops, horse purslane is a serious weed of Pakistan (Nayyar *et al*., 2001). It also affects human health and agricultural products. There is a resource competition between weeds and crop and dominated by weeds because weeds are able to modify themselves according to the various agro ecological environments. Competition of weeds with the plants exaggerated by spacing between the plants, size of the leaf present in plant, emergence time and height of the plant (Hamayun, 2003). In Pakistan, *Trianthema portulacastrum* is frequent in crops grows in summer and in the field of vegetables (Hashim and Marwat, 2002). Horse purslane caused reduction in crop yield by covering the land area and form green carpet which disturb the main crop (Senthil *et al*., 2009). Horse purslane aggressiveness is higher in mungbean field as compared to other weeds information available on the horse purslane infestation in scare.

MATERIAL AND METHODS

Experimental Site

Experiment was performed at research area of the MNS-University of Agriculture Multan, Pakistan. Field was prepared by three plowing with two planking. A fine seedbed was prepared for mungbean. Mungbean variety AZRI-2016 was sown during 4th week of June. The mungbean plants were spaced at 10 cm and rows were spaced at 30 cm. Crop was sown through drill by using 30 kg seed ha^{-1}. ½ bag of Urea per acre was applied at 1st irrigation. 1 bag Sulphate of Potash and 1 bag DAP (Diamonium phosphate) was used at land preparation time. Thrice watering was done till harvesting of the crop.

Experimental Design and Treatments

The experiment was consisted of 10 treatments including T_1 (weed free for the whole season), T_2 (horse purslane free for 20 days after emergence, DAE), T_3 (horse purslane free for 40 DAE), T_4 (horse purslane free for 60 DAE), T_5 (all weeds free for 20 DAE), T_6 (all weeds free for 40 DAE), T_7 (all weeds free for 60 DAE), T_8 (weedy check with all weeds), T_9 (weedy check except horse purslane) and T_{10} (weedy check containing only horse purslane) The experiment was conducted under RCBD (Randomized complete block design and was repeated thrice.

Observations

Data related to weeds frequency, relative frequency, weed relative density and mungbean yield related traits i.e. number of grains per pod, number of pods per plant, 1000 grains weight, grains yield (t ha^{-1}) were kept in record. Weed infestation data were recorded using 1 m^{-2} quadrate at interval of 15 days. After the removal of all the weeds plant in a quadrat, weeds plants were oven dried at 70 ^{0}C for 48 hours for the measurement of dry weight. Density, frequency and frequency percentage in relative terms were measured by the formula given by Yakubu *et al*., 2010 and Tauseef *et al*., 2012.

Randomly 10 plants of mungbean were selected from each plot and number of pods per plant, number of grains per pod, 1000 grains weight and grain yield were measured. By using SPAD-502 plus chlorophyll contents were measured at fifteen days interval and terminated at 80 days after sowing.

$$\text{Frequency \%} = \frac{\text{Number of sampling unit having target species}}{\text{Total number of sampling unit}} \times 100$$

$$\text{Relative frequency \%} = \frac{\text{Frequency of target species}}{\text{Sum of frequencies of all species}} \times 100$$

$$\text{Relative density} = \frac{\text{Total number of individuals of particular species}}{\text{STotal number of individuals of all weed species}} \times 100$$

RESULTS

Total Weeds Density (m^{-2})

At 45 DAS, highest weeds density (11.80 m^{-2}) was noticed in all weeds weedy check plots as shown in the Fig. 1. The lowest weeds density (2.01 m^{-2}) was observed at 15 DAS in T_3 (horse purslane free for 40 DAE). At 30 DAE, results showed that T_5 (9.13 m^{-2}, all weeds free for 20 DAE) has maximum weed density and T_3 (3.66 m^{-2}, horse purslane free for 40 DAE) has lowest weed density. In T_6 (All weed free for 40 DAE) and T_7 (all weed free for 60 DAE), no weeds were observed.

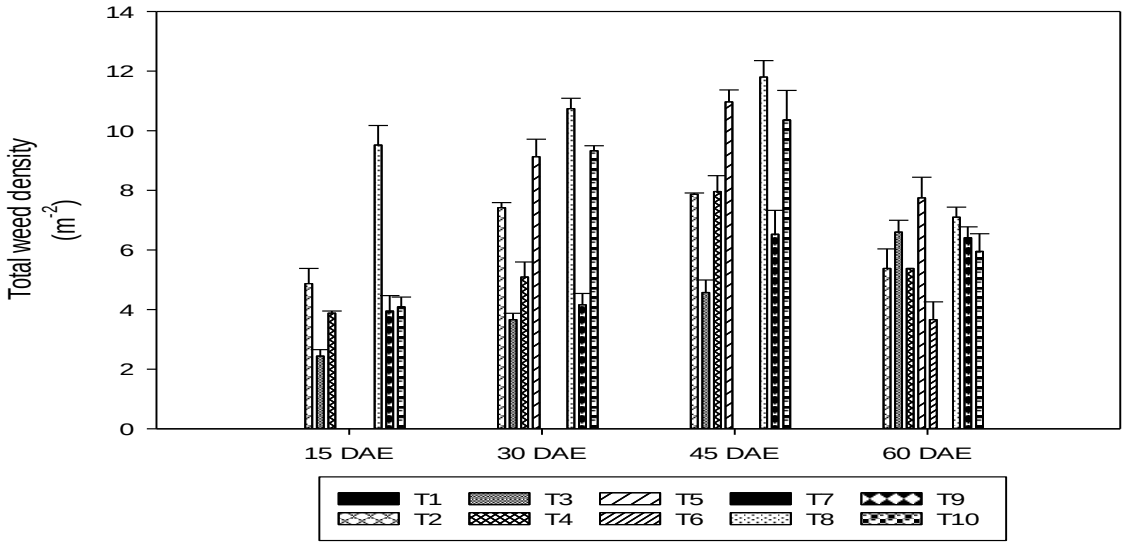

Figure 1. Total weeds density (m^{-2}) due to horse purslane interference in mungbean.
(T_1: weed free whole season, T_2: horse purslane free for 20 DAE, T_3: horse purslane free for 40 DAE, T_4: horse purslane free for 60 DAE, T_5: all weed free for 20 DAE, T_6: all weed free for 40 DAE, T_7: all weed free for 60 DAE, T_8: weedy check all weeds, T_9: weedy check except horse purslane, T_{10}: weedy check containing horse purslane)

Total Weeds Dry Weight (g m^{-2})

At 45 DAE of the crop, weeds are at their full groom attaining the maximum dry weight. Total weed dry weight (44.40 g m^{-2}) was highest at 45 DAE in T_8 (all weeds weedy check). The dry weight of total weeds declined at 60 DAE due to its maturity. At 15 DAE, the minimum total weeds dry weight (1.52 g m^{-2}) was recorded in the plot where horse purslane was kept free for 20 DAE. At 15 DAE, in T_1 (weed free whole season), T_5 (all weeds free for 20 DAE), T_6 (all weed free for 40 DAE) and T_7 (all weed free for 60 DAE), there is no dry matter was observed. At 30 DAE of the crop, T_8 (18.22 g m^{-2}, weedy check all weeds) has maximum dry weight followed by T_{10} (16.69 g m^{-2}, weedy check containing horse purslane) containing horse purslane for whole season of the crop. Treatment T_3 (4.40 g m^{-2}, horse purslane free for 40 DAE) has lowest dry weight. At 60 DAE, T_{10} (28.74 g m^{-2}, weedy check containing horse purslane) has higher weed dry weight followed by T_8 (29.98 g m^{-2}, weedy check all weeds) and T_5 (17.22 g m^{-2}, all weeds free for 20 DAE). Treatment T_9 (2.98 g m^{-2}, weedy check except horse purslane) has lowest dry weight followed by T_2 (7.07 g m^{-2}, horse purslane free for 20 DAE).

Horse Purslane Density (m^{-2})

At 15 DAE, higher horse purslane density was noticed in T_{10} (28.97 m^{-2}, weedy check containing horse purslane) because it contains only horse purslane for whole season till harvesting of the crop and lower in the T_8 (weedy check all weeds, 25.37 m^{-2}). At 30 DAE, maximum horse purslane frequency was observed in T_{10} (12.63 m^{-2}) followed by T_8 (weedy check all weeds, 10.89 m^{-2}) and lowest in T_2 (horse purslane free for 20 DAE, 5.45 m^{-2}). At 45 DAE, maximum horse purslane weed density was observed in T_{10} (weedy check only horse purslane, 18.08 m^{-2}) followed by T_8 (weedy check all weeds, 12.63 m^{-2}) and lowest in T_2 (horse purslane free for 20 DAE, 6.20 m^{-2}). At 60 DAE, horse purslane has maximum density in T_{10} (weedy check only horse purslane, 18.08 m^{-2}) followed by T_5 (all weeds free for 20 DAE, 10.89 m^{-2}), T_2 (horse purslane free for 20 DAE, 9.04 m^{-2}) and lowest in T_8 (weedy check all weeds, 7.19 m^{-2}).

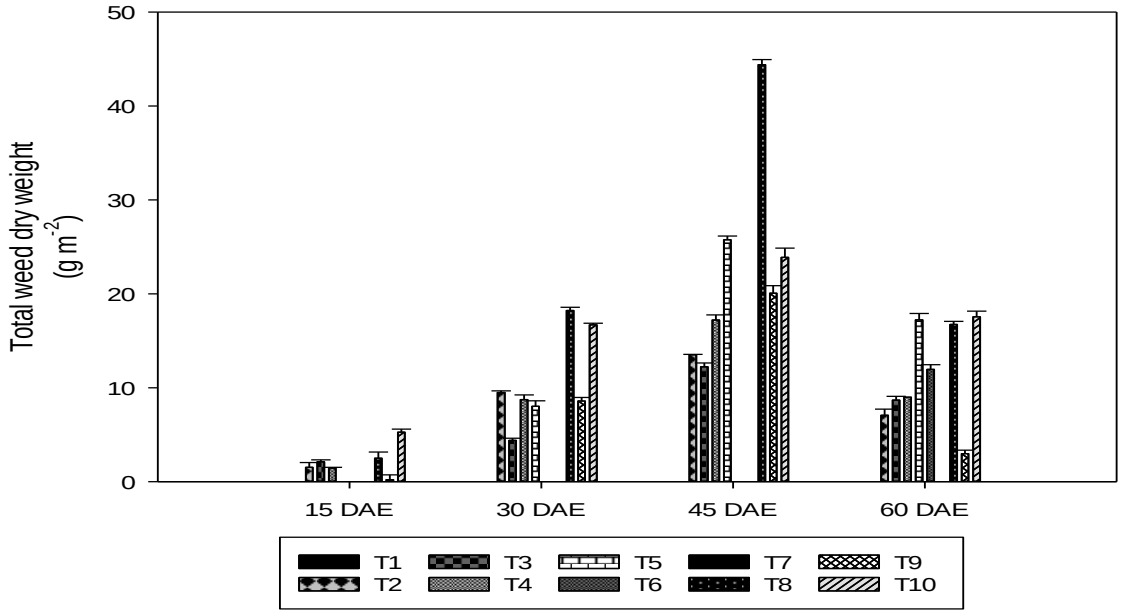

Figure 2. Total weeds dry weight (g m^{-2}) due to horse purslane interference in mungbean.

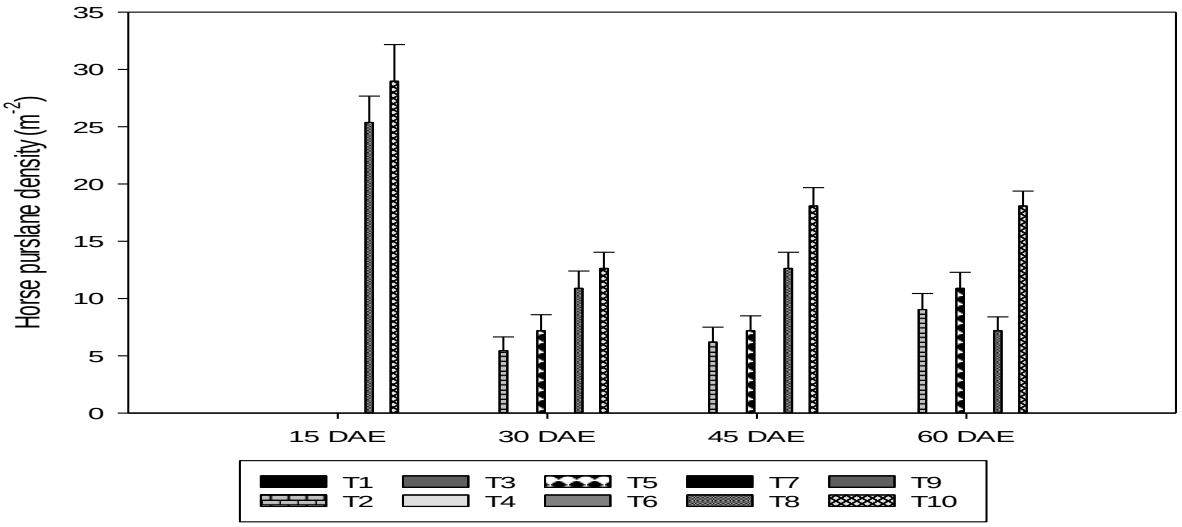

Figure 3. Horse purslane density (m^{-2}) due to other weeds interference in mungbean.

Horse Purslane Dry Weight (g m^{-2})

Results concerning dry weights of horse purslane showed that T_{10} (51.90 g m^{-2}, weedy check containing horse purslane) has maximum dry weight as followed by T_8 (50.67 g m^{-2}, all weeds weedy check) at 15 DAE. In treatments, T_5 (all weeds free for 20 DAE), T6 (all weeds free for 40 DAE), T_7 (all weeds free for 60 DAE) and T_9 (weedy check except horse purslane) have no horse purslane dry weight at 15, 30, 45 and 60 Days after emergence of the crop. In these treatments, weeds are controlled manually. At 30 DAE, T_8 (62.15 g m^{-2} weedy check all weeds) has maximum dry weights of horse purslane followed by T_{10} (46.61 g m^{-2} weedy check containing horse purslane). T_2 (11.76 g m^{-2}, horse purslane free for 20 DAE) has higher dry weights of weeds than T_5 (5.77 g m^{-2}, all weeds free for 20 DAE). At 45 DAE, horse purslane has maximum dry weight in the treatment T_{10} (55.10 g m^{-2} weedy check containing horse purslane) and T_8 (34.96 g m^{-2} weedy check all weeds) followed by T_2 (9.69 g m^{-2}, horse purslane free for 20 DAE) and lower in T_5 (9.47 g m^{-2}, all weeds free for 20 DAE). At 60 DAE, maximum horse purslane dry weight

was observed in T_{10} (weedy check only horse purslane, 77.75 g/m^2) and lowest in T_5 (all weeds free for 20 DAE, 1.09 g/m^2) was observed. In T_8 (weedy check all weeds, 31.36 g m^{-2}) and T_2 (horse purslane free for 20 DAE, 12.09 g/m^2) was recorded.

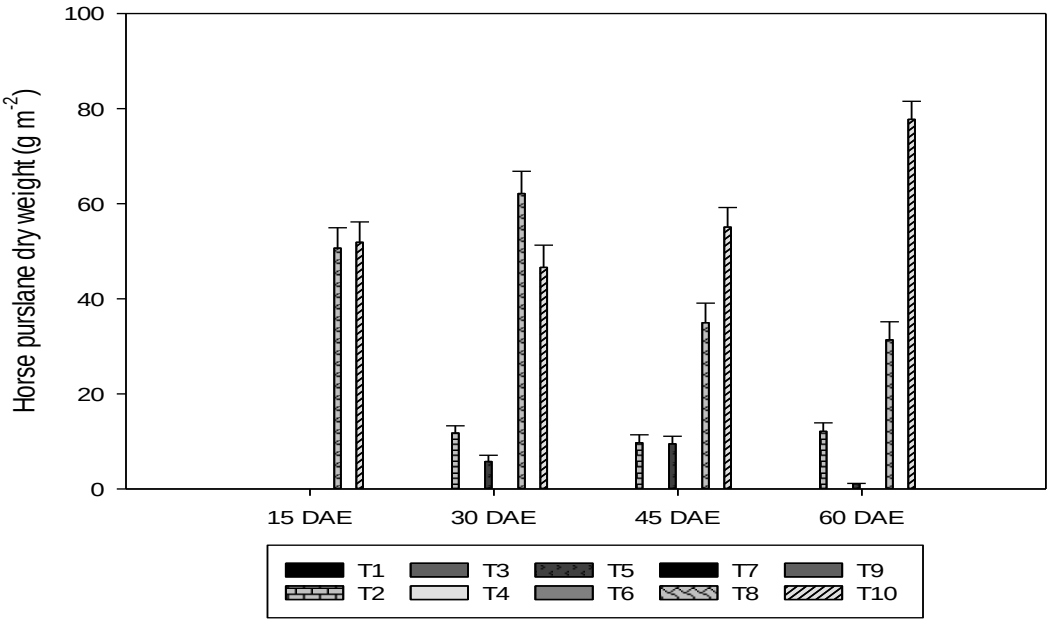

Figure 4. Horse purslane dry weight (g) due to other weeds interference in mungbean.

Horse Purslane Frequency (%) due to other Weeds Interference in Mungbean

At 15 DAE, horse purslane frequency (100%) was found only in two treatments i.e., T_8 (all weeds weedy check) and T_{10} (weedy check except horse purslane). At 30, 45 and 60 DAE, 100% frequency of horse purslane was noticed in T_2 (horse purslane free for 20 DAE), T_8 (all weeds weedy check) and T_{10} (weedy check only horse purslane) whereas 66.66% horse purslane frequency was found in T_5 (all weeds free for 20 DAE).

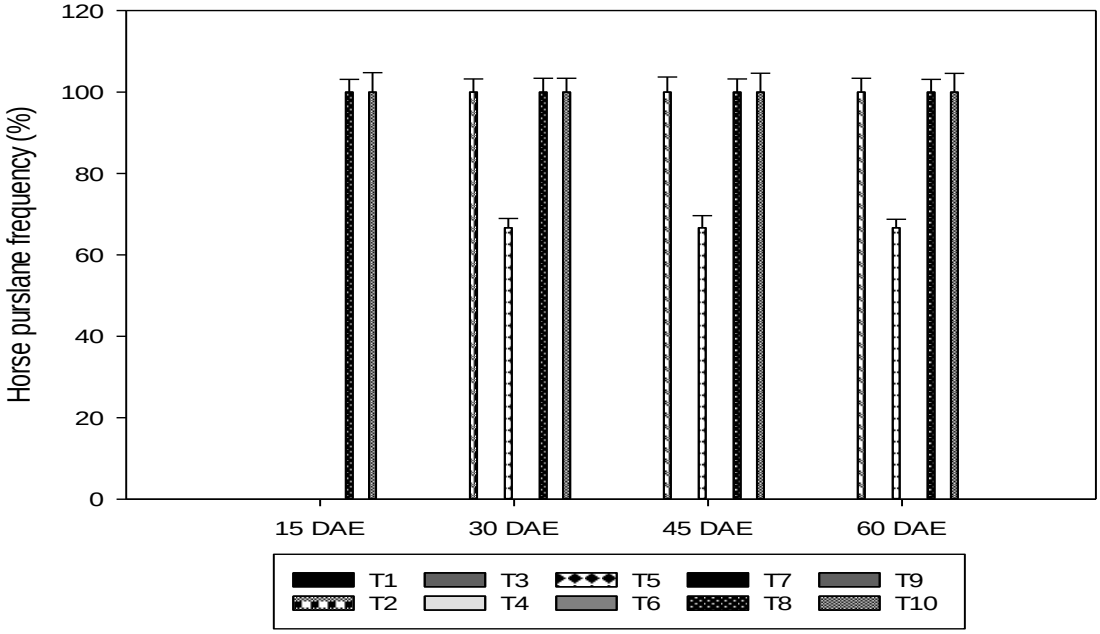

Figure 5. Horse purslane frequency (%) due to other weeds interference in mungbean.

Horse Purslane Relative Frequency (%) due to Interference by other Weeds in Mungbean

Relative frequency is the specific weed dominance over other weeds infesting an area over specific time. Maximum relative frequency (%) horse purslane (150%) was noticed at 45 DAE in T_2 (horse purslane free for 20 DAE). At 15 DAE, T_8 (weedy check all weeds) and T_{10} (horse purslane weedy check) has 100% horse purslane relative frequency. At 30 DAE, T_5 (all weeds free for 20 DAE) and T_{10} (weedy check only horse purslane) also has 100% horse purslane relative frequency followed by 75% in T_2 (horse purslane free for 20 DAE).

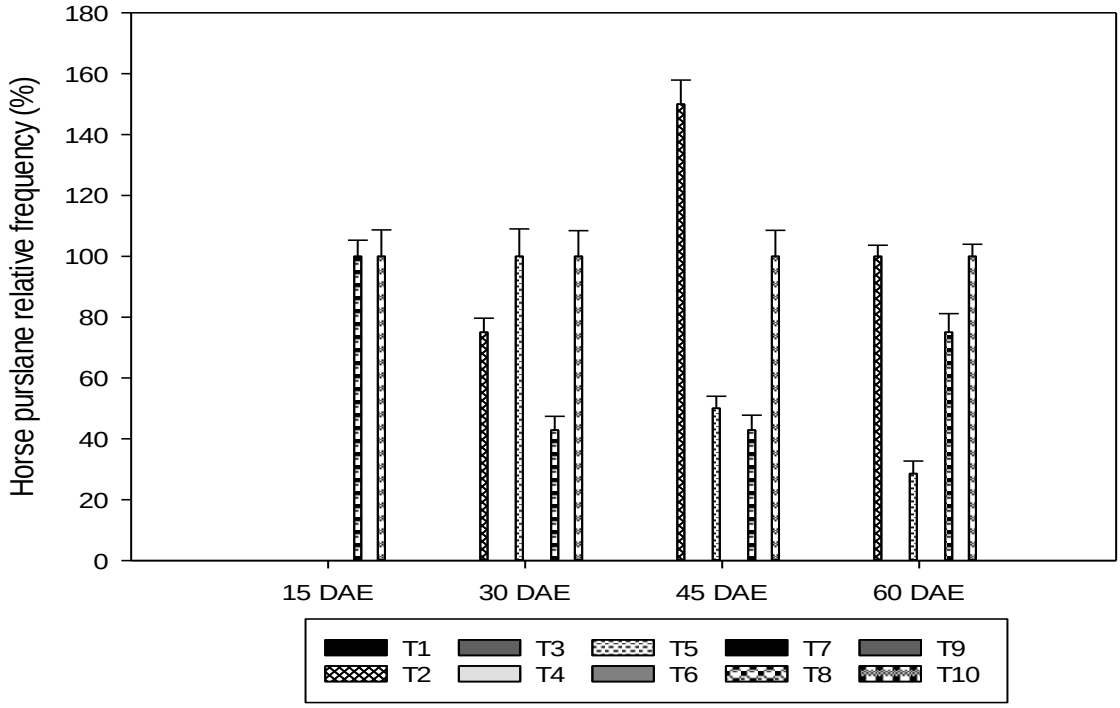

Figure 6. Horse purslane relative frequency (%) due to other weeds interference in mungbean.

Relative Density (m^{-2}) of Horse Purslane as affected by other Weeds Interference in Mungbean

Relative density represents the vigour of specific species as compared to sum of all the species present over a specific time. At 30 and 45 DAE, relative density of horse purslane was 78.74 m^{-2} each in T_2 (horse purslane free for 20 DAE) and T_5 (all weeds free for 20 DAE) followed by 73.35 m^{-2} in T_2 (horse purslane free for 20 DAE). T_{10} (horse purslane weedy check) has the lowest horse purslane relative density (30.62 m^{-2}) at 60 DAE.

Chlorophyll Contents (SPAD value)

Chlorophyll contents are measured at vegetative, flowering, pod filling and maturity stages. Figure 8 clearly showed that chlorophyll contents increase as the crop age increase. In a leaf tissue concentration of chlorophyll content is an excellent sign of photosynthetic activity (Chowdhury and Kohri, 2003).

Yield Traits

Yield traits were significantly influenced by weed interference treatments ($p<0.05$). Maximum pods $plant^{-1}$ (31.33) were taken in the plots where weeds were kept free through whole crop season and it was similar with all weeds free for 40 DAE and 60 DAE where the pods $plant^{-1}$ were 28.00 and 29.00, respectively.

Table clearly showed that number of grains pod^{-1} decreases with increasing of weed density. Number of grains pod^{-1} (13.00) were maximum in weeds free (whole season) plots, and it was statistically close to plots with all weeds kept free for 60 DAS where the number of grains pod^{-1} were 11.33. Lowest number of grains pod^{-1} (6.67) were recorded in weedy check (all weeds present) plot.

Heavier 1000 grain weight (69.40 g) was observed in weeds free plot followed by 65.17 g in a plot where all the weeds were kept free for 60 DAE. The lowest 1000 grains weight (45.33 g) was observed in plot which containing all weeds for whole season.

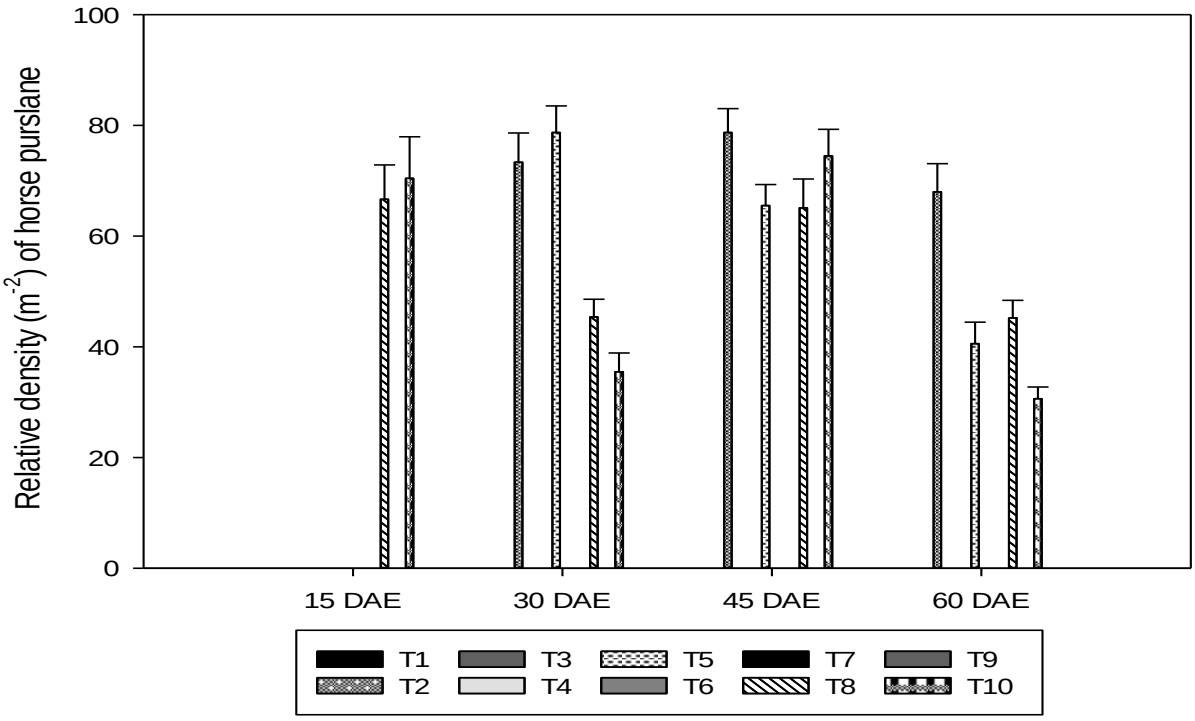

Figure 7. Relative density (m^{-2}) of horse purslane due to other weeds interference in mungbean.

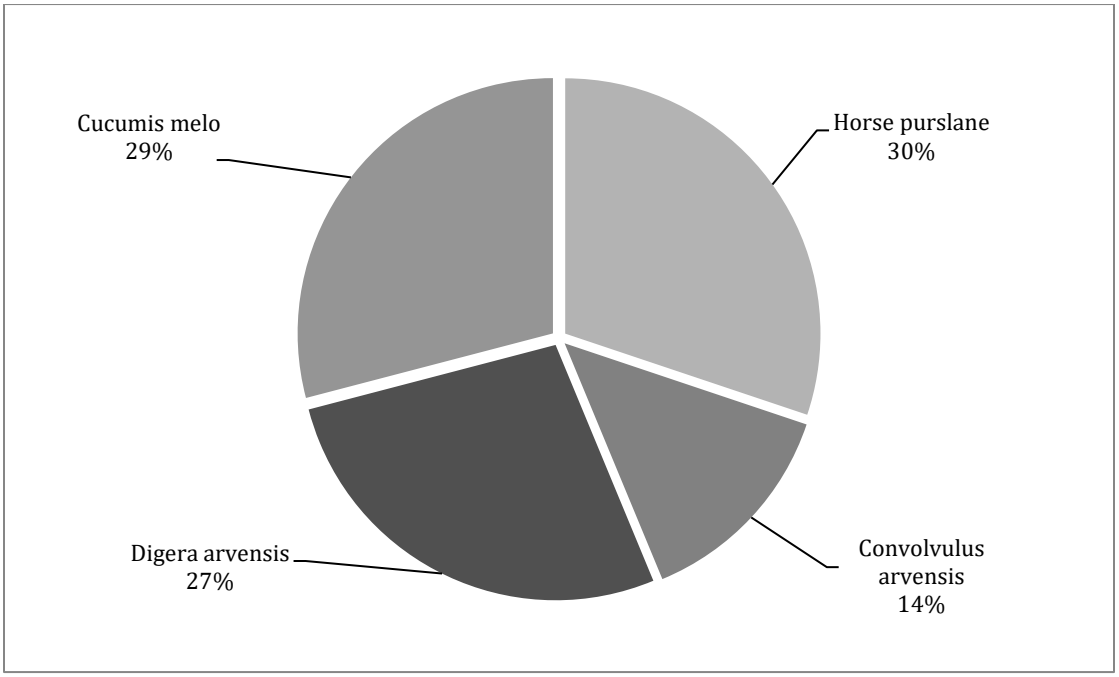

Figure 7. Weeds relative density vs total weeds relative density at 45 DAE.

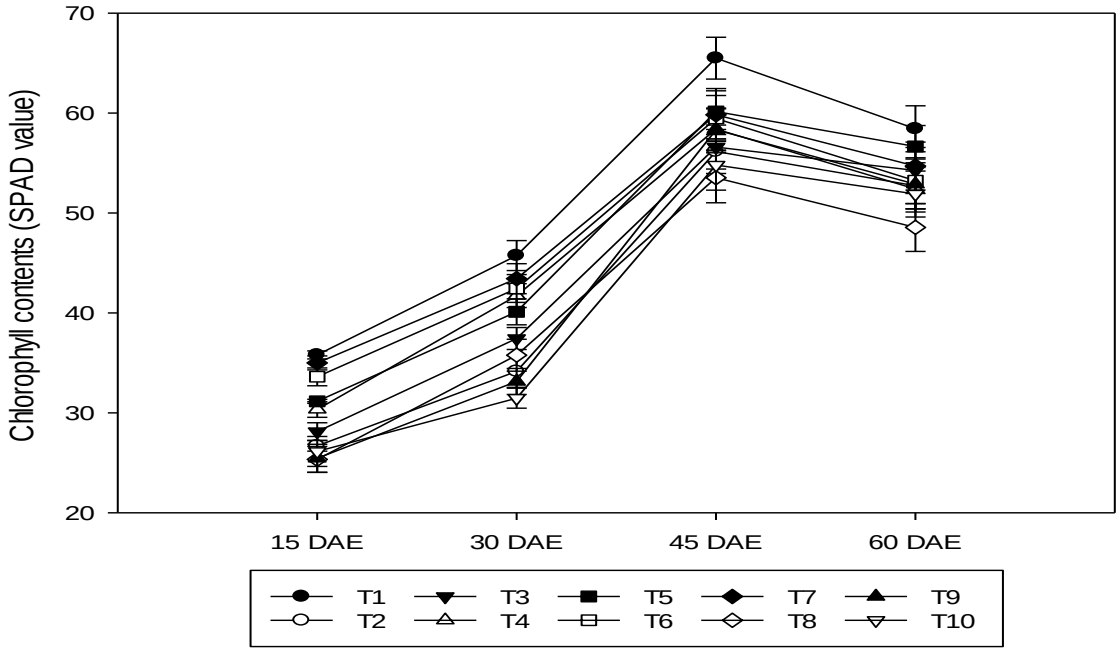

Figure 8. Chlorophyll contents (SPAD value) of mungbean as affected by horse purslane interference in mungbean.

DISCUSSION

Results indicated that total weed density of weed increases as the crop age increases. Density of different weeds starts increasing at 15- 45 days after emergence of the crop. After 45 days after emergence of the crop, weed density declines because weed enters into the reproductive stage and starts drying and shading of the leaves occurs. Weed density was higher in weed containing plots because weeds are growing according to the treatments for whole season. Similar findings are revealed by (Chinnusamy and Chinnagounder, 2013; Hargilas *et al*., 2015).

Total weed dry weight of weed increase as the weed age increases. Dry weight of weeds starts increasing at early stage and declines at 60 DAE of the crop. Broad leaves weeds contain maximum weight as compared to narrow leaf weed. Broad leaf weed form a carpet on the surface of the soil causing the competition results in lower yield. Similar results are found by (Cheema *et al*., 2005; Hallikeri *et al*., 2004). Horse purslane is one of the serious weed in maize and cotton crops in Pakistan. It grows best in warm season and moist condition of the soil. Horse purslane covers the top surface of the soil and suppresses the growth of the subsequent crop. Higher densities of weeds results in higher weed dry biomass. Higher density of horse purslane results in lower yield, crop growth and net profits. Horse purslane has an allelopathic effect on the other weeds. Density of horse purslane suppress with the sorghum shoot water extract (Cheema & Ahmad, 1992). Increasing weed density caused reduction in yield due competition (Baye and Bouhache, 2007). Highest density of horse purslane was noticed (28.97 m^{-2}) in only horse purslane containing plots. In these plots, conditions are favorable for the horse purslane growth. Horse purslane grows quickly as compared to other weeds. Minimum value (5.45 m^{-2}) was observed. This is due to competition and allelopathic nature of the weeds. Similar findings are revealed by Punia *et al*., 2004, asked that yield was reduced with each increment of horse purslane weed density (10, 20, 40, 80 and 160 plants m^{-2}). In mungbean, plant density affects the grain yield (Jahan and Hamid 2004).

Horse purslane is an annual broad leaf and fast growing weed. In a rainy season, it grows fast. At 35-45 days after emergence, horse purslane growth was maximum. At this stage, horse purslane produced higher biomass. Horse purslane forms a dense canopy cover over the other weeds. Weed biomass significantly affected by different management practices. Maximum horse

purslane weed dry biomass was obtained (77.75 g/m^2) and minimum (1.09 g/m^2) in different weed management practices. This is due to horse purslane was at flowering stage and gains maximum dry biomass. Dry biomass declines because horse purslane enters into the maturity stage. Higher weed dry biomass has significant effect on the growth and yield of the crop. Severity in weed duration and weedy dry biomass affect the nutrient uptake in different crops (Stoimenova, 1995). Results are close line with Khan *et al.,* 2008, concluded that different biomass of weeds was obtained with different weed management practices.

Maximum frequency (%) was noticed in horse purslane containing plots. This could be due to the favorable conditions of environment and soil. It was found that higher weed frequency (more than 95%) was observed under favorable environment. Minimum relative frequency (28.57%) of horse purslane was observed at 30 DAE in T_5 (all weeds free for 20 DAE) which shows that other weeds become dominant in research trial which suppress the horse purslane weed. Higher horse purslane frequency at 45 DAE could be due to better growth and development under suitable environment. In T_{10}, only horse purslane grows for whole season and becomes dominant without the competition of other weeds and availability of nutrients and moisture was more and in T_8 density of horse purslane reduced due to allelopathic cause of the other weeds infestation. Relative density of horse was high at 45 days because environmental and soil factors are favorable for growth. At 60 days after emergence, a relative density declines due allelopathic effect or may be horse purslane completes his life cycle.

Data regarding weeds relative density at 45 DAE is represented in the Fig.7 showed that horse purslane recorded the highest relative density (30%) as compared to others weeds. 35-40 DAE, horse purslane grows quickly because its vegetative and reproductive growth occurs at the same time (Das, 2008). Horse purslane forms a green carpet on the surface of the soil causing the competition for moisture, light, space and light resulting in lower yield of mungbean crop. Relative density of wild melon (29%), field bind weed (14%) and false amaranth (27%) was noticed at 45 DAE in all weeds weedy check plots. Higher densities of weeds results in stunted plant growth. These results also support Khaliq *et al.,* (2002) who said that suppression of weed increase the plant height and helps in better development. However, eight plants per m^2 of field bind weed reduced the grain yield significantly of wheat crop. Maximum chlorophyll contents (65.50) were observed at 45 DAS in the plot where weeds were kept free for whole season. Higher chlorophyll contents at this stage were because of crop attained the maturity. The minimum chlorophyll contents (25.34) were observed at 15 DAS in T_8 (all weeds weedy check) followed by T_9 (weedy check except horse purslane) where chlorophyll contents were 25.45. At 60 DAS, chlorophyll contents start declining because mungbean plant complete his life cycle and shattering and drying of the leaves starts. Maximum chlorophyll contents were noticed in weed free plots because there is no competition of weeds with the plants and minimum were noticed in weedy plots due to competition of weeds for nutrients, light, space and moisture. Results regarding chlorophyll contents are close line with (Hakim *et al*., 2013; Oyerinde *et al*., 2009).

The least number of pods plant^{-1}, (15.78) were observed in all weeds weedy check rather than the other treatments because weeds severely caused competition for space and nutrients. In weed free conditions, mungbean plants have the maximum chances to obtain the soil nutrients. In a weedy check plots, weeds like *Convoluus arvensis* makes a circle around the plants and starts affecting the number of pods per plant in mungbean. It caused competition for space, light, moisture and nutrients. Findings are similar (De Costa *et al*., 1999). Weeds affect the grains by producing the allelochemicals and caused competition i.e., moisture and nutrients. Integrated weeds management produced higher number of grains pod^{-1} due to the availability of sufficient water and nutrient availability (Khan *et al*., 2005).

The decrease in 1000 grains weight could be due to the competition of weeds, which affects the grain size, shape, quality and color of seed in mungbean crop (Halford *et al*., 2001; Santos *et al*., 2006). Grain yield (1.9 t ha^{-1}) was observed maximum in weeds free plot. It was followed by 1.7 t ha^{-1} in the plots where all weeds kept free from growth for 60 DAE. Minimum grain yield (1.01 t ha^{-1}) was observed in a weedy check (all weeds) followed by 1.09 t ha^{-1} in a plot where horse purslane was kept free for 20 DAE. Results are quite in agreement with the outcomes of Khan *et al*., 2005, in green gram, Mundra *et al*., 2003 in wheat crop, Raman and Krishnamoorthy, 2005; Patil *et al.,* 2014, in mungbean crop.

Table 10. Effect of Horse purslane interference on yield related traits of mungbean.

Treatments	Number of pods plant^{-1}	Number of grains pod^{-1}	Grain yield (t ha^{-1})
Weeds free (whole season)	31.333 a	13.00 a	1.9 a
Horse purslane free for 20 DAE	20.000 cde	7.667 de	1.09 gh
Horse purslane free for 40 DAE	23.000 c	8.333 cde	1.4 de
Horse purslane free for 60 DAE	26.773 b	9.333 bcd	1.5 cd
All weed free for 20 DAE	21.667 cd	10.333 bc	1.25 f
All weed free for 40 DAE	28.000 ab	10.667 abc	1.6 bc
All weed free for 60 DAE	29.00 ab	11.333 ab	1.7 b
Weedy check (all weeds)	15.780 f	6.667 e	1.01 h
Weedy check (except horse purslane)	19.000 def	8.333 cde	1.2 fg
Weedy check (only horse purslane)	16.773 ef	7.667de	1.3 ef
Tukey' s HSD value	9.49	9.12	5.46

Means sharing the same letter could not differ significantly at 5% Probability level.

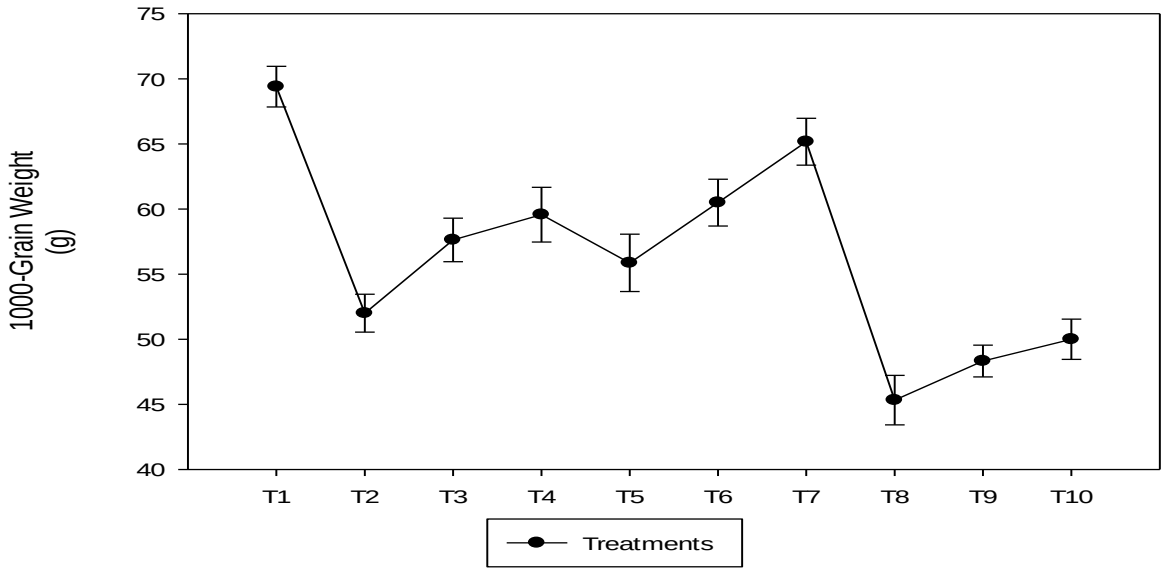

Figure 9. Effect of horse purslane interference on thousand grain weight (g) of mungbean.

CONCLUSION

Maximum density of horse purslane was recorded 30 %, wild cucurbit 29 %, Purple nutsedge 27 %, and Field bindweed 14 % at 45 days after emergence. Horse purslane caused maximum reduction in mungbean yield in comparison with other weeds. Hence, from above discussion, it is clear that horse purslane sole has more aggressivity and interference potential than the other weeds and cause damage to productivity of mungbean. However, for obtaining maximum yield of mungbean, farmers should control all weeds for 40 days after emergence of the crop.

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