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Effect of Weeds Infestation Rate on the Grain Yield and Yield Components of Lentil (Lens culinaris med.) Under Rainfed Conditions

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Abstract
To investigate the effect of the weed infested and weed free conditions on the grain yield and yield components of lentil (*Lens culinaris* Med.), fields experiments were carried out during rabi growing season 2010-11 and 2011-12 under rainfed conditions at Barani agricultural Research Institute, Chakwal, Pakistan.Lentil grain yields were decreased on average by 62.27% when crop areas remained weed infested until harvest compared with weed free conditions throughout the cropping season. As the rate of weed infestation decreased, grain yields enhanced. The diminution in grain yields (kg/ha) in lentil because of different infestation rate of weeds occurred mostly through the reduced number of pods/plant, which in turn was somewhat the result of reduced number of secondary branches/plant.
Keywords: Grain yield, weed, infestation rate, rainfed, lentil

Introduction
Lentil crop is an important pulse crop. It is grown under rainfed and in irrigated conditions, it adds to soil fertility. It is an important source of protein (Chaudhary et al., 2011). Since mankind has always tried to enhance food production by increasing the grain yield of the crops, enhancing lentil production would be possible by improving its yield per unit area. However, the efficiency of production per unit area is low due to the lack of sound and on-time control of weeds (Mousavi et al., 2005).

Generally 20 to30% losses in grain yield are quite usual and may increase even 50%, if the crop management practices are not properly followed (Tanveer and Ali, 2003). Therefore, the management of weeds is essential for production increase. The loss of yield due to weeds has been proved in many studies. Pulses are crops whose yields vary in different years. Despite low yield of lentil, it can be reduced by as high as 84% by weeds competition (Rahimzadeh et al., 2013a). Given that the emergence rate of lentil is much slower than that of weeds and its growth rate is slower during early growth season, it is a weak competitor for weeds at germination stage and its canopy do not fully reach full ground cover for a long time after sowing. The rapid development of aerial parts of the roots of the weeds at this stage means that if they are not controlled, they will readily surmount the crop (Rahimzadehet al., 2013b).

Hence, keeping in view the weeds infestation problems which play an important role in the reduction of grain yield, the present research work was carried out to study the effect of the presence of different infestation rate of weeds on the grain yield and yield components of lentil under rainfed conditions.

Materials and Methods
The study was conducted to assess the losses incurred due to weed infestation in lentil crop during the year 2010-11 and 2011-12 at Barani Agricultural research Institute, Chakwal, Pakistan. At the time of seedbed preparation fertilizer @ 25-60-0 NPK kg^{-1}ha was applied in sandy loam soil. Lentil (Masoor-2002) @ 25 kg/ha was cultivated by hand drill at 30cm apart row spacing, plot size 1.8x5m having 3 replications and 5 treatments were maintained in Randomized complete block design (RCBD).

Treatments
The following treatments were used in the current research work throughout the cropping season:
T1: Control (weeds free)
T2: 25% weed infestation rate (8 weeds m^{-2})
T3: 50% weed infestation rate (16 weeds m^{-2})
T4: 75% weed infestation rate (24 weeds m^{-2})
T5: 100% weed infestation rate (32 weeds m^{-2})

Data recorded
The characters recorded were plant height (cm), number of secondary branches per plant, number of pods per

plant, 1000 grain weight (g) and grain yield (kg/ha).

Statistical analysis
Data collected was analysed by using Statistix version 8.1 software and the means were compared by using the Least Significant Difference (LSD) test.

Results and Discussions
The major weeds in the research area during both years were *Chenopodium album, Fumeriaindica, Soghumhelipense, Medicagopolymarpha* and *Sisymbriumvrio*with some other minor weed species. During both research years the annual dicot weeds were leading among the weed flora throughout the crop season.The prevailing weather conditions during both years are presented in fig-1. Analysis of variance showed that different density of weeds presence had significant effect on plant height, pods/plant, number of secondary branches/plant and grain yield of lentil (table-1).

Plant height (cm)
Means evaluation for the characters studied presented that plant height was decreased with the increase in the density of weeds presence, so that plant height was reduced by 27.72% in the T_5 (100% weed infestation rate) as compared to the control (weeds free). In addition, the heights of the plants exposed to weeds for T2 (25% weed infestation rate), T3 (50% weed infestation rate) and T4 (75% weed infestation rate) were decreased by 8.68, 15.17 and 21.31% as compared to control (weeds free) respectively (fig-2).Thus, as the weeds infestation rate was increased, the plants of lentil became shorter. As a result, the loss of the grain yield (kg/ha) caused by the competition with weeds can be associated to the reduction of the plant height as one of the main factors because it diminish the competitiveness of the crops for radiation. The present findings are in corroborated with the studied of (Rahimzadeh et al., 2013b).

Number of secondary branches per plant
Stem is considered as a key secondary source for storing carbohydrates in plants which can play an imperative function during grain filling stage, particularly under the stress conditions induced by weeds competition. Plant height and the number of secondary branches were important components of grain yield in lentil (Rahimzadehet al., 2013b).The means comparison for the effect of different infestation rate of weeds on the number of secondary branches per plant indicated that it was significantly decreased as the infestation rate of weeds was increased, so that there was less lentil plant for measuring its secondary branches in the treatments of 100% infestation rate of weeds. The maximum number of secondary branch (6.78) was achieved from the control treatment. So, as the infestation rate of weeds increased, the number of secondary branches produced by the plants was also decreased (fig-3). The present findings are in accordance with the investigation of (Rahimzadehet al., 2013a) and (Rahimzadehet al., 2013b) who observed that number of secondary branches decreased as the density of weeds increased.

Number of pods per plant
According to means comparison (fig-4), the maximum number of pods/plant was produced under the control weeds conditions while minimum was found in T_5 (100% weeds infestation rate). The pods/plant reduced 28.82%, 29.29%, 52.24% and 62.43% in T2, T3, T4 and T5 respectively as compared to the control (fig-4).Eftekhari*et al*. (2005) and Al Thahabi et al., (1994) investigated that weeds forced the major loss by decreasing the number of pods/plant. As the number of pods was decreased, the contribution of activated assimilates was improved. Furthermore, competition by different weeds resulted in the shedding of leaves and pathetic growth and development of the plants under the treatments of weed infestation. However, the 1000 grain weight (g) have no effect on the loss of grain yield (kg/ha) in different treatments of weeds infestation rate in lentil (fig-5).

Grain yield (kg/ha)
According to the present investigation the average lentil grain yield was significantly decreased as the infestation rate of weeds was increased. On average of two year data, the highest grain yield (827 kg/ha) was achieved from the control (weeds free) treatment while the minimum grain yield (312 kg/ha) was recorded from the T5 (100% weeds infestation rate). The improvement in grain yield due to the increase in the extent of weed control was related with the reduced in interference and the increase in the availability of such environmental resources such as soil nutrients, water, radiation and available space for growth and development of lentil plant. However, the grain yield was decreased 23.10%, 34.70%, 44.86% and 62.27% in T2, T3, T4 and T5 respectively as compared to control treatment (fig-6). Rahimzadehet al., (2013b) also found the similar results in lentil.This information is likely to be caused by the lack of serious competition between crops and weeds in these infestation rates. In fact,

although the yield of crops is decreased by the increase in the density of weeds, it should be noted that weeds emerge in different times and they have different competition potential at different times. The full presence of weeds significantly decreased grain yield (kg/ha) in lentil. Rahimzadeh et al., (2013b) and Turk and Tawaha, (2001) observed that full presence of weeds population reduced lentil grain yield by as much as 100%.

Fresh and dry weight of weeds

Result presented in the table-2 indicated that as the weed population increased, fresh and dry weight of the weeds also increased. The highest fresh weight (3325g) and dry weight (787g) of weeds were recorded in T5 (100% weeds infestation rate) while minimum fresh weight (1500g) and dry weight (245g) was measured in T2 (25% weeds infestation rate).

Conclusion

Results indicated that as weeds infestation rate increased from 25% to 100%, the lentil grain yield reduced from 23.10% to 62.27% i.e. 636 kg/ha to 312 kg/ha as compared to weed free treatment (827kg/ha) on the average of both years. Hence, weed eradication management should be well in time to get maximum crop yield under rainfed conditions.

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Table-1: Statistical Analysis of grain yield and yield components of lentil under different infestation rate of weeds treatments

Source of variation	Degree of freedom	Plant height (cm)	Secondary branches/plant	Pods/plant	1000 grain weight (g)	Grain yield (kg/ha)
Replication	2	41.8651	0.84217	5.86	31.8563	159906
Treatment	4	30.8133**	1.56545*	239.82**	1.1010^{ns}	96095**
Error	8	12.7272	0.20683	10.819	1.3078	2430
CV	-	9.12	10.23	10.4	4.73	8.71
LSD (0.05)	-	1.80	0.48	7.94	1.28	32.6
LSD (0.01)	-	2.60	0.67	11.13	1.80	45.8

*Significant at 5% probability level, **Significant at 1% probability level, ^{ns}: Non significant

Table-2: Mean fresh and dry weight (g) of weeds in different infestation rate of weeds studied during 2010-11 and 2011-12

S. No.	Treatments	No. of Weeds m^{-2}	Fresh Weight of Weeds (g)	Dry Weight of Weeds (g)
1	Control (Weeds free)	-	-	-
2	25 % Weeds infestation rate	8	1500	245
3	50 % Weeds infestation rate	16	2075	415
4	75 % Weeds infestation rate	24	2625	578
5	100 % Weeds infestation rate	32	3325	787

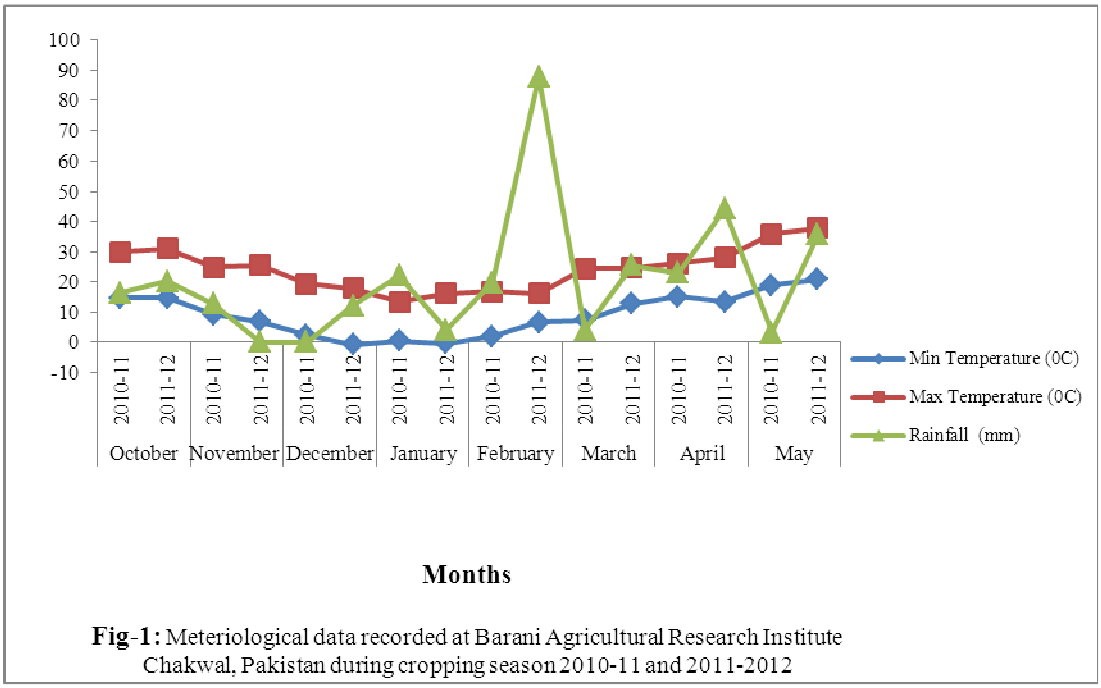

Fig-1: Meteriological data recorded at Barani Agricultural Research Institute Chakwal, Pakistan during cropping season 2010-11 and 2011-2012

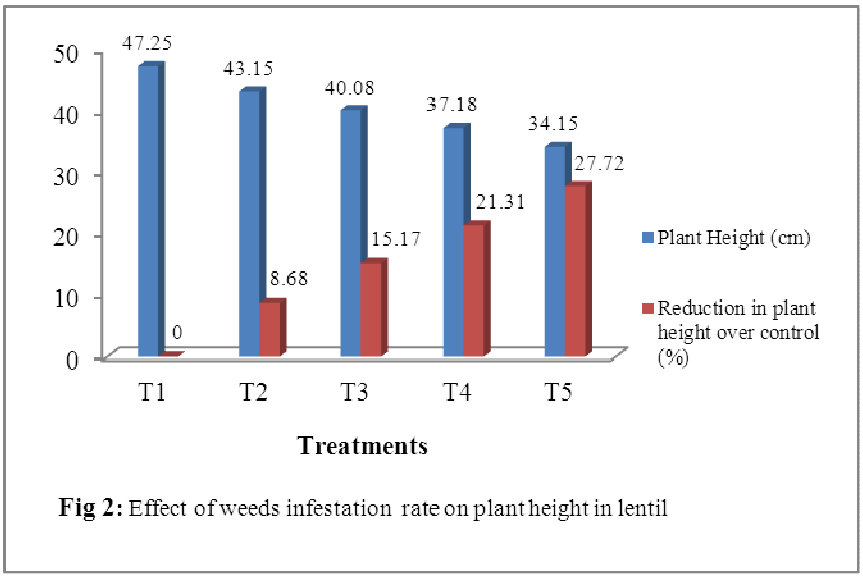

Fig 2: Effect of weeds infestation rate on plant height in lentil

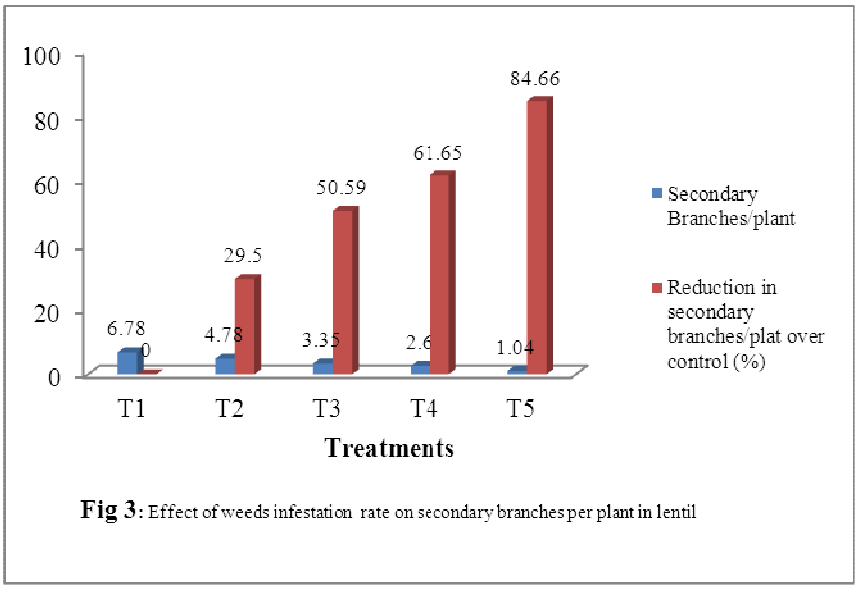

Fig 3: Effect of weeds infestation rate on secondary branches per plant in lentil

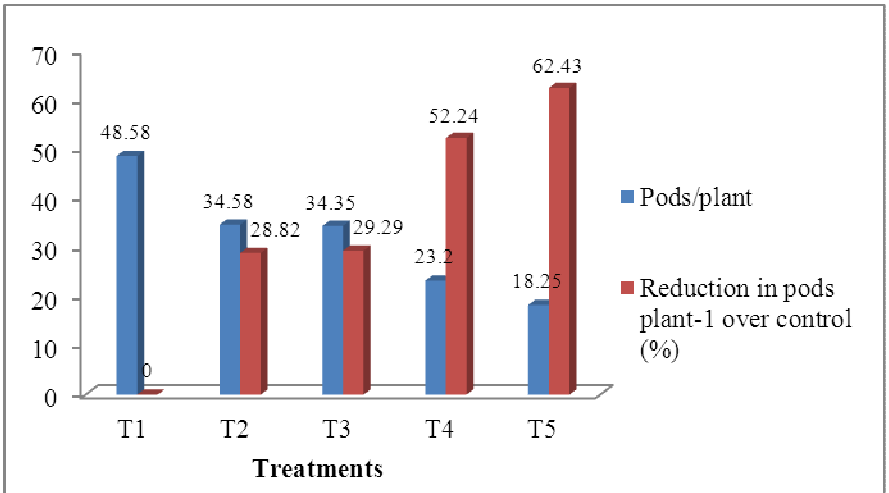

Fig 4: Effect of weeds infestation on pods/plant in lentil

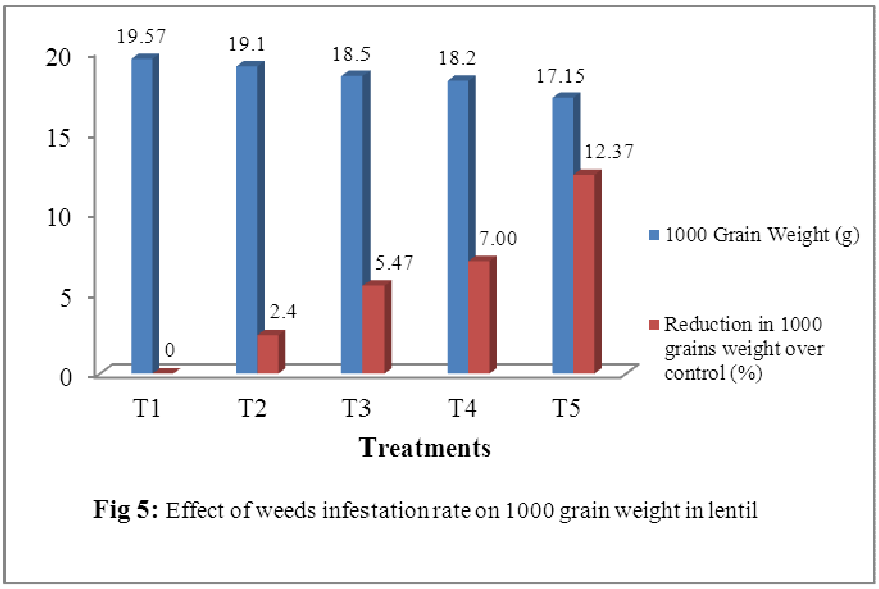

Fig 5: Effect of weeds infestation rate on 1000 grain weight in lentil

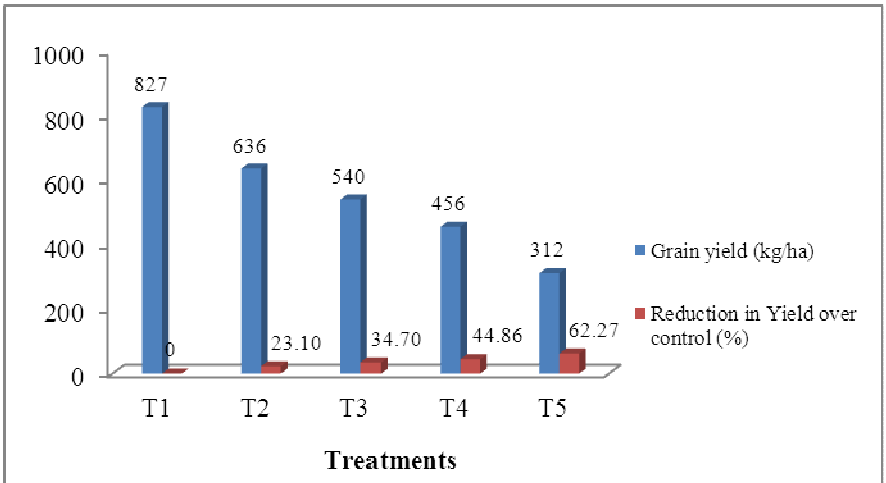

Fig 6: Effect of weeds infestation rate on grain yield in lentil

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