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Assessment of Yield Loss in Green gram (*Vigna radiata* (L.) R. Wilczek) cultivation and estimation of Weed-Free Period for Eco-friendly weed management



ROUPHAEL



Pubudu kumara¹, **Kandiah Pakeerathan^{1,*}**, and Liyanage P.P. Deepani²

¹Department of Agricultural Biology, Faculty of Agriculture, University of Jaffna, Ariviyal
Nagar, 44000, Kilinochchi, Sri Lanka

²Herbal Technology Section, Industrial Technology Institute, Bauddhaloka Mawatha,
Colombo-7, Sri Lanka

*Correspondence: pakeerathank@univ.jfn.ac.lk; Tel.: +94-077-696-9511

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Introduction

- Green gram (Mungbean)
 - Family : Fabaceae
 - Genus : *Vigna*
 - Species : *V. radiata*



- Most important grain legumes in the traditional farming systems of Sri Lanka
- Cheap sources of protein
- High percentage of easily digestible protein
- Local production shows
 - **26931 mt in 1990**
 - **11703 mt in 2010**



- 9068 ha of land is utilize
- Around 10,535 mt is domestically produced (Department of Census and Statistics, 2011)
- A large gap between the actual yield and the potential yield

- 10,447 mt  **IMPORTED**

- It reveals that 49.8% of the total green gram requirement is still being imported.

- Increasing the production is the target
- Two strategies
 1. Increase the extent of cultivation
 2. Increasing the productivity
- Land acts as a limiting factor for expanding the extent of cultivation.
- High yield per surface unit (high productivity) is the overriding need.

- Benefits of increasing green gram production would be two ways.
 1. Boosting the income level of farmers
 2. fulfilling the dietary needs of the people in the country

- Weed flora of green gram crop differ from region to region with soil conditions
- Studying the weed diversity/dynamics is helpful to understand the dominance or absence of a particular weed species in a cropping system.
- Estimating yield loss due to weeds is equally important for having better strategy for their management.

- Critical period of weed interference for a crop is a measure of crop, weed and environmental interaction.
- Critical period of weed control and crop competitiveness can be effectively utilized to develop economical and environmentally sound weed management practices (Nissanka *et al.*, 1998).

- The critical period of weed competition is an important consideration in the development of appropriate weed management strategies (Swanton and Weise, 1991).

Problem justification

- The information on critical weed free period (CWFP) for green gram in Sri Lanka is rare and enough experiments were not carried out to determine the yield loss due to weeds and critical weed free period for green gram in Sri Lanka
- It is important to provide more precise information for mungbean growers about the critical periods for weed control for maximizing the yield.

Objectives

- Determine the yield loss due to weeds in green gram cultivation in DL1 region and to decide critical weed free periods in green gram cultivation

Material and methodology

- **Description of study area**
- Located in southern province
- Under DL1 agro ecological region(Low Country Dry Zone)
- Mean annual rainfall 1020 to 1050 mm
- Average temperature 28 – 31⁰C
- Reddish Brown Earth (RBE)

- **Materials**

- ✓ MI - 5
- ✓ 55 - 65 days maturity
- ✓ One of best suited for the region
- ✓ Widely using by farmers in the dry zone
Sri Lanka

- **Land Preparation**

- ✓ Ploughed the land to the depth of 15 – 20 cm
- ✓ Disk plough and two harrowing were done
- ✓ Beds were prepared
- ✓ Seeds were established on prepared plots

- **Field Establishment**

- ✓ Plot size

- 3 × 4 m for experiment 1
- 3 x 3 m for experiment 2

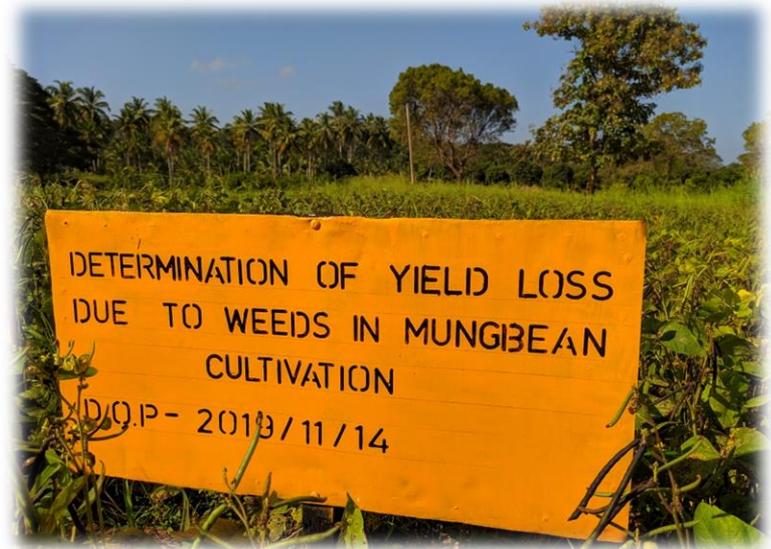
- ✓ MI – 5 variety was planted 40 cm aparted rows, in row spacing was 15 cm

- ✓ Two seeds were planted per hill

- ✓ After 2 weeks it was thin out in to one plant

Experiment 01 – Determination of Yield Loss Due to Weeds in Mungbean Cultivation

- Experiment Design and Layout
 - Randomized Block Design
 - 08 treatment
 - Three replicates.



Field layout of experiment 01(R – Replicate)

- T1 - Remove only grass and broad leaves from 2nd week to 6th week
T2 - Remove only broad leaves and sedges 2nd to 6th week
T3 - Remove only grass and sedges 2nd to 6th week
T4 - Remove all weeds 2nd to 6th week
T5 - Remove grass only 2nd to 6th week
T6 - Remove broad leaves only 2nd to 6th week
T7 - Remove sedges only 2nd to 6th week
T8 - No weed control (total weedy)

T1R1	T2R1	T3R1	T4R1	T5R1	T6R1
T4R2	T5R2	T6R2	T1R2	T2R2	T3R2
T3R3	T4R3	T5R3	T6R3	T1R3	T2R3

Data collection

1. Plant stand count at one month
2. Weed count at 3 week after planting and dry weight (Dried at 70⁰ C) of weeds
3. Weed count at 6 week after planting and dry weight (Dried at 70⁰ C) of weeds
4. Biomass weight of 10 plants
5. Numbers of pods per 10 plants
6. Weight of grain yields per 10 plants
7. Weed species in the field

Statistical analysis

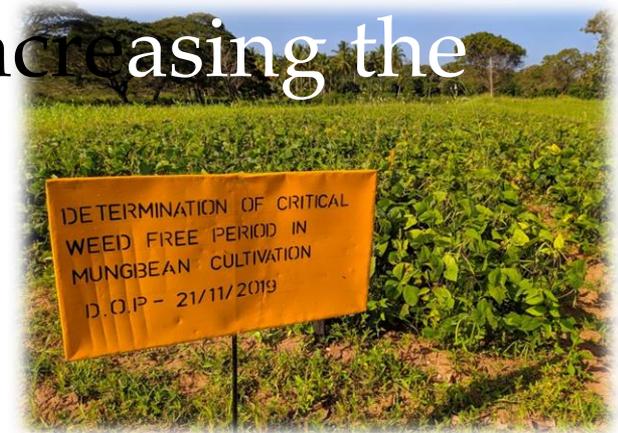
- Analysis of variance (ANOVA) –SAS statistical package
- To identify the best treatment combination, comparison between means, using DMRT at 5% level was performed



Experiment 02 – Determination of Critical Weed Free Period in Mungbean Cultivation

- **Experiment Design and Layout**

- 1st Set of treatments with increasing the length of weed free period
- 2nd Set of treatments with increasing the weedy period



First Set of Treatments - Increasing the Length of weed free Period

- T1 – Weed free up to 2 WAP
- T2 – Weed free up to 3 WAP
- T3 – Weed free up to 4 WAP
- T4 – Weed free up to 5 WAP
- T5 – Weed free up to 6 WAP
- T6 – Weed free in whole season (Control 1)
- T7 – Weedy in whole season (Control 2)

Field layout of first set of treatment of experiment 02

T1R1	T2R1	T3R1	T4R1	T5R1	T6R1	T7R1
T4R2	T5R2	T6R2	T7R2	T1R2	T2R2	T3R2
T6R3	T7R3	T1R3	T2R3	T3R3	T4R3	T5R3

Second Set of Treatments-Increasing the Weedy Period

- T1 – Weeds compete up to 2 WAP
- T2 – Weeds compete up to 3 WAP
- T3 – Weeds compete up to 4 WAP
- T4 – Weeds compete up to 5 WAP
- T5 – Weeds compete up to 6 WAP
- T6 – Weeds compete on whole season (No weeding) (Control 1)
- T7 – Weed free in whole season (Control 2)

Field layout of second set of treatment of experiment 02

T1R1	T2R1	T3R1	T4R1	T5R1	T6R1	T7R1
T4R2	T5R2	T6R2	T7R2	T1R2	T2R2	T3R2
T6R3	T7R3	T1R3	T2R3	T3R3	T4R3	T5R3

Data Collection

1. Plant stand count at one month
2. Pod weight of 10 plants per plot
3. Grain weight of 10 plants per plot
4. Total grain weight per plot
5. Weed data in each week



Identification of Available Weed Flora in the Research Field of GLORDC

- Survey on weeds was carried out at GLORDC research field with the focus of identification of available weeds in the area
- For easy identification weeds were separated in to three main categories
 - ❖ Grasses
 - ❖ Sedges
 - ❖ Broad leaves.

RESULTS AND DISCUSSION

Determination of Yield Loss Due to Weeds in Mungbean Cultivation

Yield loss due to Total population of weeds

$$= 100 - \left(\frac{\text{yield of total weed treatment}}{\text{yield of total weed free treatment}} \right) \times 100$$

$$= 100 - [(80.66 \div 178.33)] \times 100$$

$$= 54.7\%$$

- Total effect of weeds was 54.77% yield loss in research fields
- When calculated separately yield loss,
 - ❑ due to grasses was 46.56%,
 - ❑ due to BL was 16.49%
 - ❑ due to SE was 18.01%
- Combination effect of Weeds were,
 - due to Grasses and Sedges = 46.05%
 - due to Broad leaves and Sedges = 24.46 %
 - due to Broad leaves and Grasses = 45.21%

Biomass and pod yield of 10 Mungbean plants collected from Research field

Treatment	Plant stand count at 2 WAP	Biomass weight of 10 plants (g)	Number of pods/10 plants	Weight of grain/10 plants (g)
T1	77.33 ^a	416.67 ^a	260.00 ^a	146.20 ^{ab}
T2	77.00 ^a	350.00 ^{ab}	154.33 ^b	96.20 ^{cd}
T3	77.00 ^a	416.67 ^a	254.33 ^a	148.90 ^{ab}
T4	85.00 ^a	408.33 ^a	285.67 ^a	178.30 ^a
T5	86.33 ^a	400.00 ^a	213.33 ^{ab}	134.70 ^{bc}
T6	84.66 ^a	233.33 ^b	160.33 ^b	96.20 ^{cd}
T7	79.66 ^a	218.33 ^b	131.00 ^b	97.70 ^{cd}
T8	81.33 ^a	245.00 ^b	128.33 ^b	80.70 ^d
CV%	7.2	23.86	25.17	18.93
LSD (0.05)	10.2 ^{ns}	140.45	89.67	40.57

Means with the same letters are not significantly different at $\alpha = 0.05$

Determination of Critical Weed Free Period in Mungbean Cultivation

Weight of pods obtained from the trial of increasing weed free period

Treatment	Pod weight
T1 - Weedy in whole season (Control 2)	109.7 ^d
T2 - Weed free up to 2WAP	117.8 ^{cd}
T3 - Weed free up to 3WAP	124.9 ^c
T4 - Weed free up to 4WAP	127.4 ^{bc}
T5 - Weed free up to 5WAP	131.1 ^{bc}
T6 - Weed free up to 6WAP	140.4 ^{ab}
T7 - Weed free in whole season (Control 1)	152.1 ^a
CV%	6.26
LSD	14.39

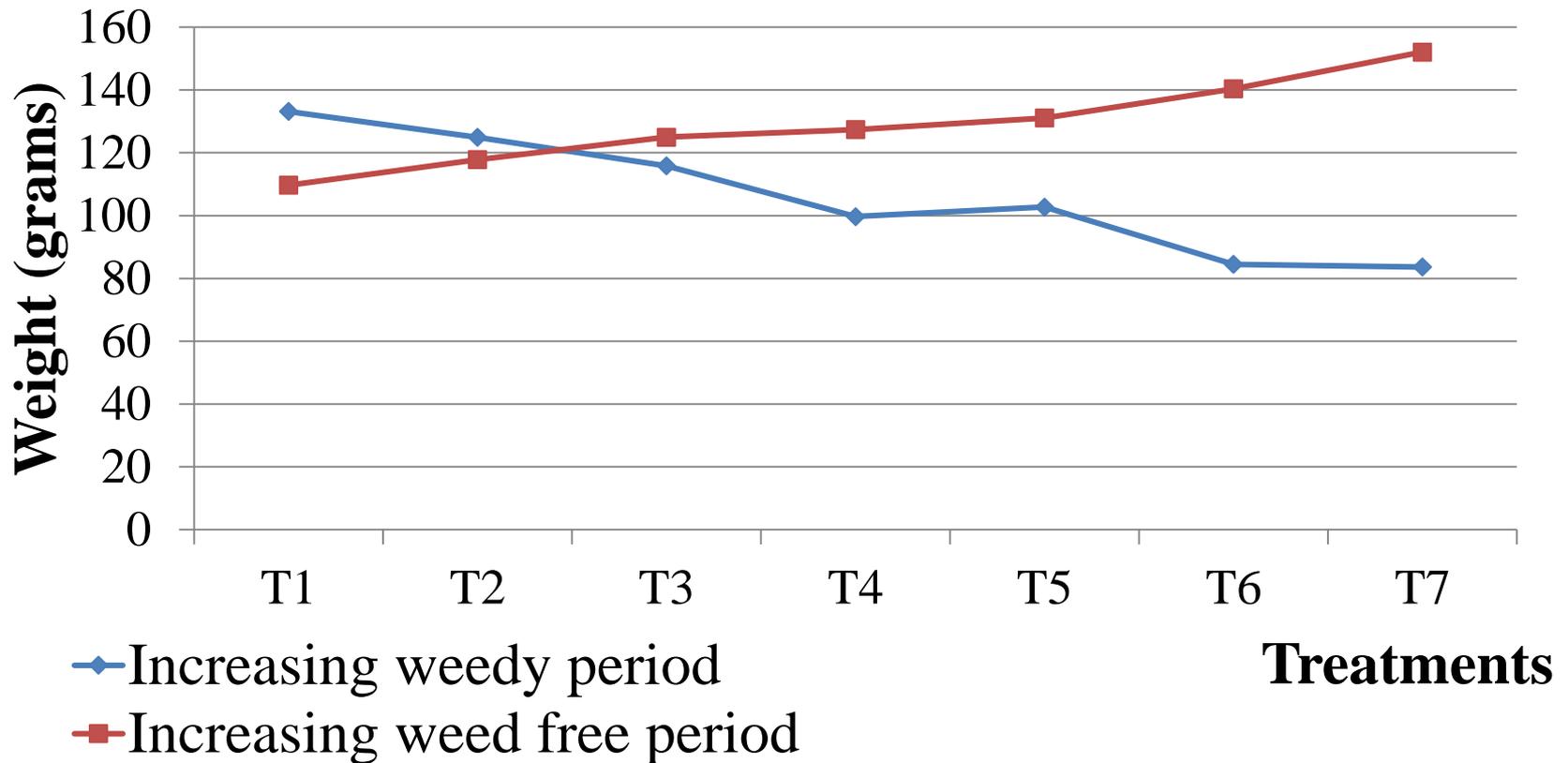
Means with the same letters are not significantly different at $\alpha = 0.05$

Weight of pods obtained from the trial of increasing weedy period

Treatment	Pod weight
T1-Weed free in whole season (Control 2)	133.1 ^a
T2-Weed compete up to 2WAP	124.9 ^{ab}
T3-Weed compete up to 3WAP	115.8 ^{abc}
T4-Weed compete up to 4WAP	102.7 ^{bcd}
T5-Weed compete up to 5WAP	99.6 ^{cd}
T6-Weed compete up to 6WAP	84.4 ^d
T7-Weedy in whole season (Control 1)	83.6 ^d
CV%	13.26
LSD	25.10

Means with the same letters are not significantly different at $\alpha = 0.05$

Pod weight - 10 plants



Weight of pods of Mungbean in weed free and weedy condition

Weight of grain obtained from the trial of increasing weed free period

Treatment	Grain weight
T1-Weedy in whole season (Control 2)	90.7 ^d
T2-Weed free up to 2WAP	98.8 ^d
T3-Weed free up to 3WAP	109.3 ^c
T4-Weed free up to 4WAP	112.5 ^{bc}
T5-Weed free up to 5WAP	115.6 ^{abc}
T6-Weed free up to 6WAP	122.5 ^{ab}
T7- Weed free in whole season (Control 1)	123.0 ^a
CV%	5.33
LSD	10.47

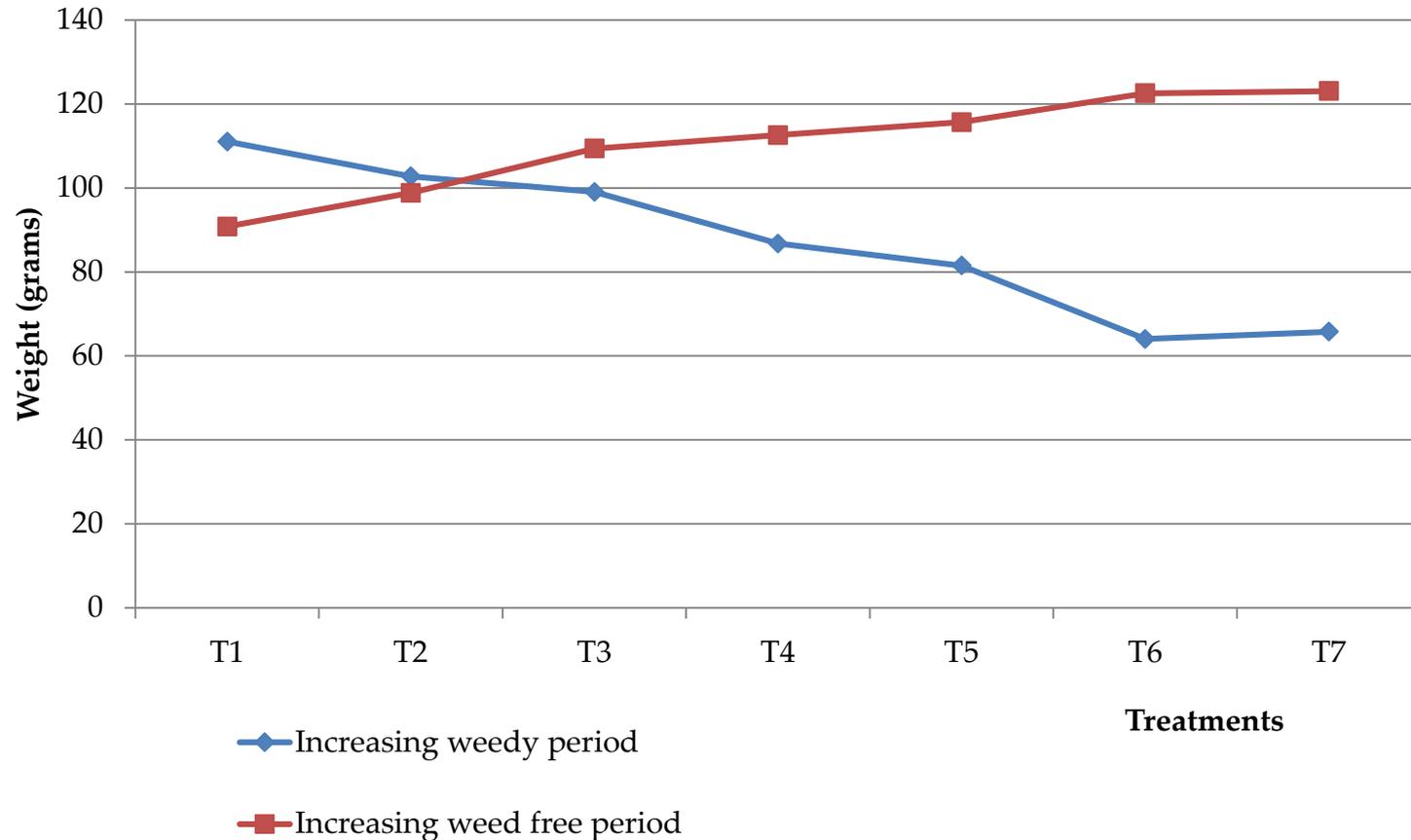
Means with the same letters are not significantly different at $\alpha = 0.05$

Weight of grain obtained from the trial of increasing weedy period

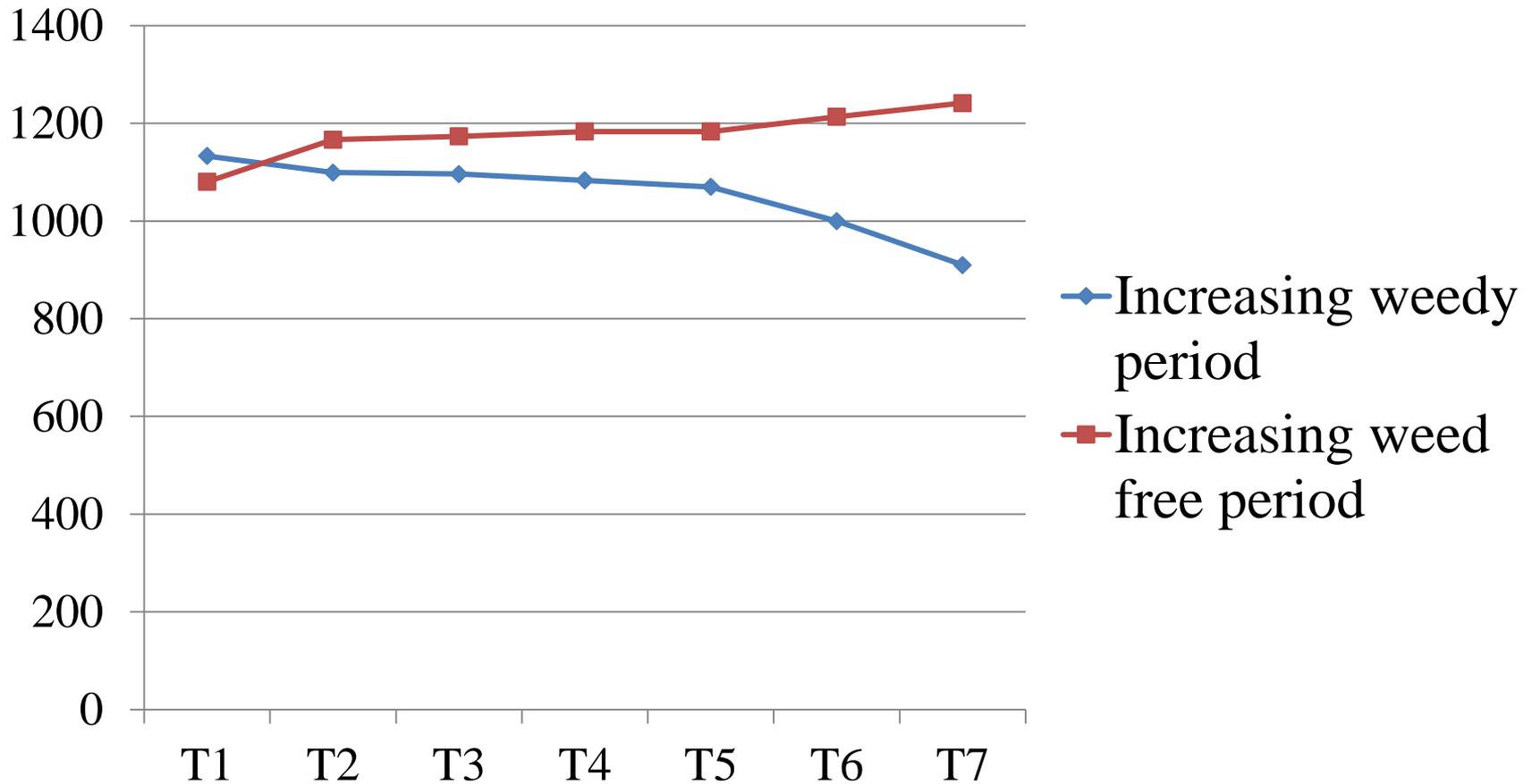
Treatment	Grain weight
T1-Weed free in whole season (Control 2)	111.0 ^a
T2-Weed compete up to 2WAP	102.7 ^{ab}
T3-Weed compete up to 3WAP	99.0 ^{ab}
T4-Weed compete up to 4WAP	86.7 ^{bc}
T5-Weed compete up to 5WAP	81.5 ^{cd}
T6-Weed compete up to 6WAP	65.7 ^{de}
T7-Weedy in whole season (Control 1)	64.0 ^e
CV%	11.25

Means with the same letters are not significantly different at $\alpha = 0.05$

Grain weight 10 plants



Grain weight of Mungbean in weed free and weedy condition



Total plot yield of Mungbean in weed free and weedy condition

Conclusion

- Grasses were the prominent weeds than Broad leaves and sedges for Mungbean at GLORDC research field
- Yield loss due to natural mixed weed population of the tested location was 54.77 %.
- Critical weed free period for Mungbean was lying between 2 to 5 weeks from planting
- Mungbean yield is decrease in some amount with the interference of the all weeds types.

Future scope

- Yield comparison of manual weeding with one or two application of recommended weedicides
- Cost benefit analysis of manual weeding with optimum weed free period and pre emergence herbicide with manual weeding and optimum weed free period
- Mixed beans cultivation and weed competition

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