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Yield and Seed Quality of Summer Green Gram as Influenced by Weed Management under Zero Tillage

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ABSTRACT

Background: Weeds are primary factors that adversely affect growth, yield and seed quality of summer green gram, which can be minimized with adoption of proper weed management practices. This field experiment was conducted to find out the effective weed management practice in summer green gram (*Vigna radiata*) under zero tillage condition.

Methods: In this field-laboratory investigation conducted during summer season 2019 on different herbicides were applied to manage weeds in summer green gram. Eight treatments were applied based on various application windows. In the field and laboratory, the collected samples were determined for growth parameters, nutrient uptakes, seed yield and seed quality of summer green gram.

Result: The result revealed that weed free treatment recorded higher growth parameters like, plant height, number of branch/plant, number of leaves/plant and root biomass which was statically at par with Shaked (Propaquizafop + Imezathyper) as post-emergence (POE) at 20 DAS and Pendimethalin as pre-emergence (PE) followed by one hand weeding 20 DAS. Same trends were also observed in seed yield, nutrient content and uptake by seeds. Seed quality parameters like germination per cent (98.00), shoot (25.63 cm) root (14.20 cm) and seedling length (39.83 cm), seedling dry weight (0.16 g), vigour index I (3903.33) and vigour index II (14.96) was higher under weed free followed by Shaked (Propaquizafop + Imezathyper) and Pendimethalin as (PE followed by one hand weeding 20 DAS over weed check.

Key words: Seed quality, Summer green gram, Vigour index, Weed management.

INTRODUCTION

Pulses are playing an important role in Indian economy as well as socio-economic condition. Pulses are rich source of protein, vitamins, fibers and minerals (iron, zinc and magnesium) and some essential amino acids which are plays a vital role in human health (Yadav *et al*., 2017). Most of Indian populations are vegetarian and pulses also contribute to about 14% of total protein supplementation of a usual diet of India. Pulses occupy a leading place in various cropping system and grow as main crop, cover crop, catch crop, inter crop and green manure crop (Mallikarjun *et al.,* 2021). Pulses improve soil health by enhanced soil physical, biological and chemical properties as well as soil fertility status through biological nitrogen fixation with symbiotic association with rhizobium from the atmosphere and mushrooming the soil microorganism population in soil (Peoples *et al.,* 2018).

Green gram (*Vigna radiata*) is an important short duration legume crop in India. It is quite versatile crop can be grown for seeds, green manure and forage as mixed or sole crop. Mungbean contains about 51.6% carbohydrate, 26 to 27% protein, 4 to 5% minerals and 3 to 4% vitamins (Dhakal *et al*., 2015). Green gram can be grown in summer season where sufficient irrigation dexterity is feasible. In summer season less extra rainfall, less cloudy condition, higher temperature and less humidity provide less infestation of pest and disease. Growth and productivity of mungbean affected by many biotic and abiotic factors like nutritional deficiency, water scarcity, pest and disease *etc*. Weeds are one of the most important factors to reduce yield of mungbean during summer and rainy season (Singh *et al.,* 2021). Being a short duration crop, it faces heavy weed competition right from the early growth stages (Pandey *et al.,* 1999). Weed competition is very high during initial 25-30 days of mungbean (Raghvani *et al.,* 1985). Weeds alone reduce mungbean yield up to 90% depending upon cultivars, soil moisture level, soil types, field condition and other environmental constraints (Kumar *et al.,* 2006 and Ali *et al.,* 2011). The yield loss of mungbean mainly depends upon types of weed flora, its intensity and period of crop-weed competition (Choudhary *et al.,* 2016).

The progressive conversion of agriculture concerning intensive use of herbicides is gaining status in recent years

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due to easy, lower cost and timeliness and success in controlling weeds (Butter *et al.,* 2008). Chemical weed controls an excellent alternative to manual as well as mechanical weeding and supply weed-free environment during early growing stage up to 30-35 days (Dungarwal *et al.,* 2003, Das and Yaduraju, 2011, 2012). Therefore, keeping above information in view, the present study was conducted to assess the effect of different weed management practices in summer green gram under zero tillage condition to find out the better combination of weed control means to get higher growth and quality of seed.

MATERIALS AND METHODS

The experiment was conducted at Agronomy Research Farm, ICAR-National Dairy Research Institute, Karnal and Haryana, located at 29°41′ N latitude and 76°58′ E longitude with an altitude of 245 m above mean sea level in Trans Indo-Gangetic Plain of India during summer season of 2019-20. The soil of experiment field was clay loam in texture having neutral pH (7.32), medium in Walkley-Black organic carbon (0.53%) and low in $KMnO_4$ Oxidizable nitrogen (164 kg/ha), medium in 0.5 M $NaHCO_3$-extractable phosphorus (19.5 kg/ha) and 1N NH_4OAC extractable potassium (227.7 kg/ha). The experiment was conducted in randomized block design consisting of eight treatments *viz*., T_1- Weedy check, T_2- Weed free, T_3-Pendimethalin (pre-emergence) @ 0.75 kg/ha, T_4- Pendimethalin followed by hand weeding at 20 DAS, T_5- Imezathyper (Post emergence) @ 75 g/ha at 20 DAS, T_6- Shaked (Propaquizafop + Imezathyper) (2 l/ha) as post emergence, T_7-Pendimethalin @ 0.75 kg/ha followed by Imezathyper @ 75 g/ha at 20 DAS and T_8-Pendimethalin @ 0.75 kg/ha followed by Quizolofop ethyl @ 50 g/ha at 20 DAS replicated thrice.

The recommended dose of fertilizer (20:30:40 kg NPK/ha) was applied as basal in the form of Urea, DAP and MOP, respectively. The required quantity of seeds (20 kg/ha) was treated with rhizobium culture and phosphorus solubilising bacterial (PSB) before sowing @ 20 g/kg of seed. The seeds were sown in row drawn 30 × 10 cm apart with 5cm deep of variety MH-421 The herbicides were applied as per treatments using knapsack sprayer fitted with a flat-fan nozzle. One hand weeding was done at 20 days after sowing as per treatment. A total six irrigations were given to the crop at 4, 17, 24, 38, 50 and 62 days after sowing. To eliminate border effect; two rows on both sides and 0.5 m length at each end of the plot was not included in the experiment and net plot area gross plot (5 × 4 m^2) and net plot area (4.3 × 3 m^2) was harvested separately from each plot.

Seed samples were collected from seed lot of each treatment and stored in cloth bags. Hundred seeds were taken for seed quality parameters *viz*: germination (%), Seedling length (cm) and seedling dry weight (g). Test weight from seed sample of seed of seed lot of each plot were taken randomly and weighed separately. The seeds were placed for standard germination at 25°C for 8 days in rolled towel paper (B.P. Method) (ISTA Method, 2019).

$$\text{Germination percentage} = \frac{\text{No. of seeds germinated}}{\text{Total no. of seeds}} \times 100$$

Five seedlings were taken randomly from germinated seedlings of each plot and their length was measured with the help of centimetre scale and average was expressed as seedling length in centimetre (cm) after that same five seedlings are dried in a hot air oven at 70°C till constant weight was obtained and average was expressed as dry weight g/seedling. The seedling vigour expressed after 8 days setting the experiment. Seedling vigour index was determined by the formula given by Abdulbaki and Anderson (1973).

Seedling vigour index I = Germination % × Seedling length (cm)

Seedling vigour index II =
Germination % × Seedling dry weight (g)

Five plants were selected and recorded various growth data. The seed samples were collected at harvesting and oven dried (70°C) then grinded in a wiley mill to pass through 2 mm sieve. The sieved samples were used for the estimation of nutrients contents in seed. Nutrient uptake by crop (seeds) are obtained by multiplying dry matter yield kg/ha and nutrient content (%).

$$\text{Nutrient uptake (kg/ha)} = \frac{\text{Nutrient concentration in seeds (\%)} \times \text{Dry matter (kg/ha)}}{100}$$

Data on growth, seed quality parameters, nutrient contents and uptake were subjected to analysis of variance given by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Effects on growth parameters

Plant height, number of leaves/plant, number of branches/plant and LAI was significantly affected by various weed control practices at 30 DAS and harvest (Table 1). It was noticed that above mentioned parameters were increasing trend with ageing of the crop. Weed free recorded highest plant height (32.70 and 57.00 cm), number of leaves/plant (25.10 and 48.03) and number of branches/plant (4.30 and 5.87) at 30 DAS and harvest and LAI (4.11) at harvest followed by Pendimethalin as PE followed by one hand weeding at 20 DAS and Shaked (Propaquizafop + Imezathyper) as POE. In weedy check, it was recorded minimum growth parameters might be because of overcrowding of weeds during entire crop growth period. All other weed management treatments were recorded significantly higher growth parameters over weedy check. This might be due to efficient weed control and reduce the crop weed competition for available resources. Similar results were recorded by Komal *et al.* (2015).

The weed control practices were significantly affected the number and dry weight of nodules /plant and root biomass at 40 DAS (Table 2). The highest nodules number/

plant (27.03), nodule dry weight (0.29 g) and root biomass (0.56 g) was recorded in weed free treatment which was at par with Pendimethalin as PE followed by one hand weeding at 20 DAS (24.15, 0.26 g and 0.50 g, respectively). Among various treatments, weed free recorded (99.77%) higher nodules number over weedy check. However, application of Pendimethalin (PE) followed by one hand weeding 20 DAS, Propaquizafop followed by Imezathyper) as post emergence at 20 DAS and Pendimethalin (PE) followed by Imezathyper (POE) at 20 DAS were recorded lower nodules number plant as compare to weed free by 10.65, 15.39 and 25.26%, respectively. Hand weed was recorded more nodules/plant and root biomass. Increased in number of nodules and root biomass under hand weeding treatments due to improve aeration of rhizosphere and improve soil condition. These results were similar with findings of Khairnar *et al.* (2013) and Chhodovadia *et al.* (2011).

Effects on seed yield

Result showed that weed management practices significantly influence seed yield (Fig 1). Weed free treatment produced significantly highest seed yield (10.10 q/ha) which was at par on Pendimethalin (PE) followed by one hand weeding 20 DAS (9.49 q/ha) and Shaked (Propaquizafop + Imezathyper) as POE at 20 DAS (9.47 q/ha). Pendimethalin (PE) followed by one hand weeding 20 DAS, Shaked as post emergence at 20 DAS and Pendimethalin (PE) followed by Imezathyper (POE) at 20 DAS were recorded lower seed yield as compare to weed free by 6.03, 6.23 and 10.49%, respectively. Higher growth attributes lead to higher DM production ultimately leads to higher yield. This might be because of efficient weed control by herbicides when combined with hand weeding which finally influenced growth parameters and yield. Raman and Krishnamoorthy (2005) were also found the similar results.

Effects on nutrients content and uptake by seed

The results revealed that weed management practices does not reported significant variation on N, P and K content of seed (Fig 2) but nutrients uptake significantly affected by weed management practices. The highest nitrogen, phosphorus and potassium uptake by seed (39.10, 4.74 and

Table 1: Effects of different weed management practices on plant height, number of branches/plant and number of leaves/plant at 30 DAS and harvest.

Treatments	Plant height (cm)		Number of branches/plant		Number of leaves/plant	
	30 DAS	Harvest	30 DAS	Harvest	30 DAS	Harvest
Weed check	16.07	32.17	1.97	2.49	13.93	20.87
Weed free	32.70	57.00	4.30	5.87	25.10	48.03
Pendimethalin (PE)	21.43	42.13	3.15	3.38	18.03	29.80
Pendimethalin (PE) followed by one HW 20 DAS	28.40	53.80	3.74	5.02	20.93	41.37
Imezathyper (POE) at 20 DAS	21.60	42.93	3.42	3.53	18.13	31.73
(Propaquizafop + Imezathyper) as POE at 20 DAS	24.60	48.07	3.50	4.08	19.93	39.47
Pendimethalin (PE) followed by Imezathyper (POE) at 20 DAS	23.00	45.67	3.47	3.75	18.73	35.00
Pendimethalin (PE) followed by Quizolofop ethyl at 20 DAS	22.03	43.67	3.48	3.63	19.03	33.10
SEM (±)	1.39	2.81	0.17	0.26	1.06	2.12
CD (p=0.05)	4.20	8.51	0.52	0.79	3.20	6.43

Table 2: Effects of different weed management practices on root biomass/plant, number of nodule/plant and nodule dry weight at 40 DAS and LAI at harvest.

Treatments	Root biomass/ plant (g)	Number of nodule plant	Noduledry weight (g)	LAI
	40 DAS	40 DAS	40 DAS	Harvest
Weed check	0.31	13.53	0.13	2.30
Weed free	0.56	27.03	0.29	4.11
Pendimethalin (PE)	0.38	17.17	0.18	2.77
Pendimethalin (PE) followed by one HW 20 DAS	0.50	24.15	0.26	3.57
Imezathyper (POE) at 20 DAS	0.40	17.70	0.19	2.87
(Propaquizafop + Imezathyper) as POE at 20 DAS	0.43	22.87	0.22	3.40
Pendimethalin (PE) followed by Imezathyper (POE) at 20 DAS	0.42	20.20	0.21	2.95
Pendimethalin (PE) followed by Quizolofop ethyl at 20 DAS	0.41	18.23	0.20	2.92
SEM (±)	0.03	1.16	0.01	0.18
CD (p=0.05)	0.08	3.52	0.04	0.55

14.67 kg/ha, respectively) was observed under weed free followed by Pendimethalin (PE) followed by one hand weeding 20 DAS (35.65, 4.32 and 13.05 kg/ha, respectively). All weed control measures tended to enhance the nutrient uptake by seed compared to weedy check (Table 3). As nutrient uptake by crop is a function of yield and nutrient content. Application of herbicides and hand weeding leads to, more uptakes of nutrients by crop due to minimum crop weed competition had parallel increased in nutrient availability, superior crop growth and higher crop biomass production tied with more nutrient content. These results are harmony with finding of Chhodavadia *et al.* (2013), Komal *et al.* (2015) and Kaur *et al.* (2010).

Effects on seed quality parameters

The data mentioned in Table 4 showed that the use of weed management treatment significantly affected the germination per cent, shoot, root and seedling length of mungbean.

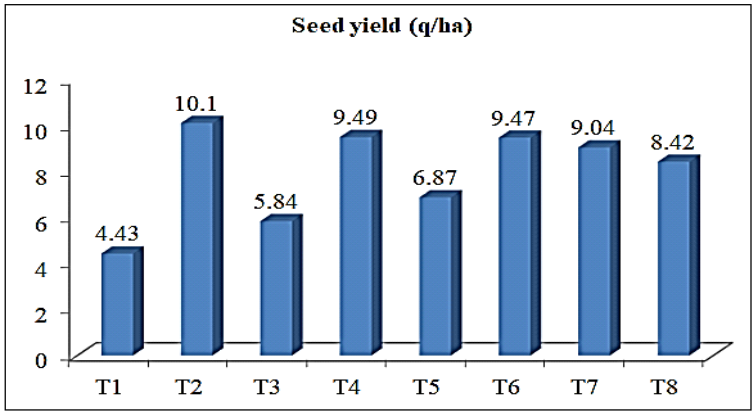

Fig 1: Effects of weed management practices on seed yield.

T_1- Weedy check, T_2 - Weed free, T_3 - Pendimethalin (PE) @ 0.75 kg/ha, T_4- Pendimethalin *fb* HW at 20 DAS, T_5- Imezathyper (POE) @ 75 g/ha, T_6- Shaked (Propaquizafop + Imezathyper) (2 l/ha) (POE), T_7- Pendimethalin @ 0.75 kg/ha *fb* Imezathyper @ 75 g/ha at 20 DAS and T_8- Pendimethalin @ 0.75 kg/ha *fb* Quizolofop ethyl @ 50 g/ha at 20 DAS.

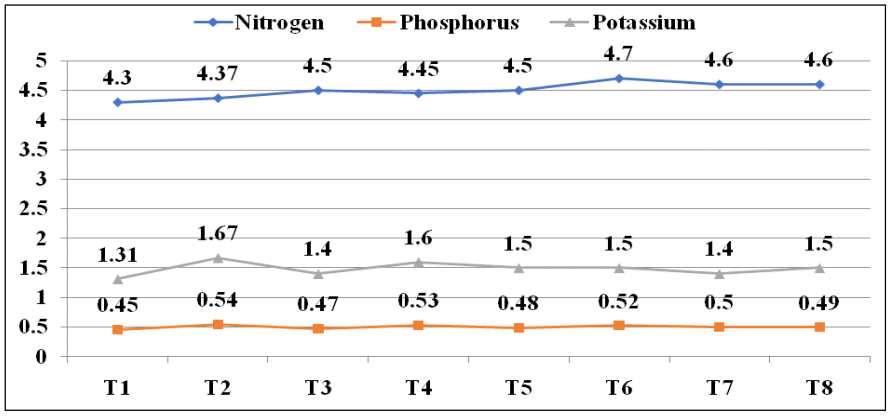

Fig 2: Effects of weed management practices on N, P and K content (%) in seed.

Table 3: Effects of different weed management treatments on N, P and K uptake by seed.

Treatments	N uptake by seed (kg/ha)	P uptake by seed (kg/ha)	K uptake by seed (kg/ha)
Weed check	15.62	1.63	4.76
Weed free	39.10	4.74	14.67
Pendimethalin (PE)	21.81	2.28	6.79
Pendimethalin (PE) followed by one HW 20 DAS	35.65	4.32	13.05
Imezathyper (POE) at 20 DAS	26.27	2.80	8.76
(Propaquizafop + Imezathyper) at 20 DAS	38.26	4.23	12.21
Pendimethalin (PE) followed by Imezathyper at 20 DAS	34.93	3.80	10.63
Pendimethalin (PE) followed by Quizolofop ethyl	32.92	3.51	10.74
SEM (±)	1.02	0.20	0.32
CD (p=0.05)	3.10	0.92	0.96

Table 4: Effects of different weed control treatments on germination %, shoot, root and seedling length.

Treatments	Germination percentage	Shoot length (cm)	Root length (cm)	Seedling length (cm)
Weed check	85.33	22.57	10.10	32.67
Weed free	98.00	25.63	14.20	39.83
Pendimethalin (PE)	92.33	23.17	12.50	35.67
Pendimethalin (PE) followed by one HW 20 DAS	95.33	24.43	13.73	38.17
Imezathyper (POE) at 20 DAS	93.67	23.27	12.83	36.10
(Propaquizafop + Imezathyper) as POE at 20 DAS	94.33	23.47	13.33	36.80
Pendimethalin (PE) followed by Imezathyper (POE) at 20 DAS	94.00	23.13	12.83	35.97
Pendimethalin (PE) followed by Quizolofop ethyl at 20 DAS	94.33	23.63	13.07	36.70
SEM (±)	0.51	0.20	0.26	0.28
CD (p=0.05)	1.55	0.60	0.78	0.85

Table 5: Effects of different weed management treatments on seedling dry weight, seedling vigour index I and II.

Treatments	Seedling dry weight (g)	Seedling vigour index I	Seedling vigour index II
Weed check	0.13	2787.73	11.75
Weed free	0.16	3903.33	14.96
Pendimethalin (PE)	0.14	3293.33	13.60
Pendimethalin (PE) followed by one HW 20 DAS	0.15	3638.50	14.31
Imezathyper (POE) at 20 DAS	0.15	3381.63	13.96
(Propaquizafop + Imezathyper) as POE at 20 DAS	0.15	3471.70	14.15
Pendimethalin (PE) followed by Imezathyper at 20 DAS	0.15	3381.07	13.91
Pendimethalin (PE) followed by Quizolofop ethyl at 20 DAS	0.15	3461.90	14.30
SEM (±)	0.02	35.51	2.18
CD (p=0.05)	0.01	107.70	NS

Weed free treatment recorded significantly highest germination percentage (98%) followed by Pendimethalin as PE followed by one hand weeding at 20 DAS (95.33%) and Pendimethalin as PE followed by Quizolofop ethyl at 20 DAS (94.33%). Weedy check was observed significantly lowest germination percentage (85.33%). Weed free was recorded significantly highest shoot, root and seedling length (25.63, 14.20 and 39.83 cm, respectively) followed by pendimethalin as PE followed by one hand weeding at 20 DAS (24.43, 13.73 and 38.17 cm, respectively) which was at par on pendimethalin as PE followed by Quizolofop ethyl at 20 DAS over weed check. Weedy check was recorded significantly lowest shoot, root and seedling length (22.5, 10.1 and 32.67 cm, respectively).

The analyzed data on seedling dry weight, seed vigour index - I of green gram is recorded in Table 5 which showed that significant effect observed due to the weed management treatments same time vigor index II did not significantly affected. Weed free was observed significantly highest seedling dry weight, vigour index I and II (0.158 g, 3903 and 14.96, respectively) followed by Pendimethalin as PE followed by hand weeding 20 DAS (0.156 g, 3638 and 14.31 respectively). Weedy check was recorded significantly lowest seedling dry weight, seed vigour index I and II (0.13 g, 2787.67 and 11.75).

Higher seed quality might be due to less competition with crop by weeds for nutrients, moisture, space and air, by control of weeds, finally leads to improve health, growth and seed quality parameter of mungbean. Pendimethalin as PE followed by one hand weeding at 20 DAS and Shaked treatment significantly reduce weed infestation and improve seed quality parameters. These results are harmony with finding of Chaubey *et al.* (2016).

CONCLUSION

Based on finding of experiment it may concluded that application of Shaked (Propaquizafop + Imezathyper) @ 2 l/ha at 20 DAS may recommended to higher growth, yield and seed quality of summer green gram under zero tillage condition.

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