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Response of planting techniques and weed management practices in rainy season Mungbean (*Vigna radiata* L.)

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Abstract

A field experiment was conducted during Kharif season of 2024 at Crop Research Centre Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut (U.P.), India. The experimental soil was low in organic carbon, nitrogen and medium in available P and K. The experiment was laid out in split plot design, keeping three planting techniques (Flatbed without residue, Furrow planting without residue and Furrow planting with Residue) in main plots and four weed management practices viz. two hand weeding at 20 and 40 DAS, Pendimethalin 1kg/ha (PE) fb fluazifop-p-butyl 150g/ha (PoE) at 15 DAS, Propaquizafop 75g/ha (PoE) at 15 DAS and weedy check were kept in sub plots with three replication. The result indicate that in main plot the furrow planting with residues techniques significantly reduced the weed population and dry weight effectively over furrow planting without residues. The tallest plants, higher number of branches plant, dry matter accumulation, weed control efficiency, nutrient uptake and grain yield was recorded with two hand weeding at 20 and 40 DAS followed by Pendimethalin 1kg/ha (PE) fb fluazifop-p-butyl 150g/ha (PoE) at 15 DAS which established its superiority over rest of the treatments. Similarly, two hand weeding at 20 and 40 DAS resulted into higher gross return, net return and B: C ratio. The total nitrogen, phosphorus and potassium uptake by green gram crop were recorded higher under two hand weeding at 20 and 40 DAS respectively

Keywords: Green gram, planting techniques, weed management practices, split plot design, grain yield

Introduction

Pulses are the edible seeds of leguminous plants cultivated for both food and feed. Among them, beans (*Phaseolus* and *Vigna* spp.), chickpea, and pea are the most commonly consumed, though several other varieties are cultivated worldwide. Pulses contribute significantly to food security, nutrition, health, climate change mitigation, and biodiversity. Recognizing their importance, the United Nations General Assembly (UNGA) designated 10 February as World Pulses Day (WPD), building on the success of the International Year of Pulses (IYP) in 2016 implemented by FAO. This annual celebration highlights the fundamental role of pulses in developing efficient, inclusive, resilient, and sustainable agri-food systems for better production, nutrition, environment, and livelihoods.

Among pulses, mungbean [*Vigna radiata* (L.) Wilczek] is widely cultivated across tropical and subtropical countries throughout the year. However, global statistics on its area and production are not separately maintained. In India, mungbean is one of the most important pulse crops, cultivated on ~3.02 mha, mainly in Rajasthan, Maharashtra, Andhra Pradesh, Karnataka, Odisha, and Bihar. The area, production, and productivity of kharif mungbean increased from 0.55 to 0.99 mha, 0.24 to 0.63 mt, and 438 to 640 kg/ha, respectively, between 2000–01 and 2014–15 (Project Coordinator's Report on MULLaRP, 2015–16). In Uttar Pradesh, during 2014–15, mungbean was cultivated on 34,000 ha with production of 19,000 tonnes and productivity of 559 kg/ha (FAI Statistics, 2014–15).

After chickpea and pigeon pea, mungbean is the third most important pulse crop in India, belonging to the family Fabaceae, subfamily Faboideae. It is cultivated across East and Southeast Asia and the Indian subcontinent, accounting for ~16% of the total pulse area in India. Mungbean is a protein-rich legume (20–25%), often used for food, fodder, and green manuring. Plants are also ploughed back into soil to enrich nitrogen. It is cultivated in both kharif and summer seasons, with summer crops generally yielding higher due to controlled irrigation,

abundant sunshine, and lower pest/disease incidence. Its short duration, low water requirement, and drought tolerance make it a suitable crop for rainfed as well as irrigated conditions.

Nutritionally, mungbean is an excellent source of protein (25%) with high lysine content (460 mg g⁻¹) and tryptophan (60 mg g⁻¹). Sprouted seeds are rich in vitamin C (8 mg 100 g⁻¹) and contain riboflavin (0.21 mg 100 g⁻¹) and minerals (3.84 g 100 g⁻¹). Despite its importance, mungbean productivity in India remains low due to poor genetic potential, susceptibility to pests, and weed infestation. Weeds are among the most critical yield-reducing factors, competing with crops for nutrients, water, light, and space. Yield losses in mungbean due to weeds have been reported to range from 23.5–45.8% (Punia *et al.*, 2004) [3] and up to 65–79% (Dungarwal *et al.*, 2003) [9].

Planting techniques also play a crucial role in mungbean productivity. Furrow planting has been found superior to broadcasting in terms of plant height, number of branches, and 100-seed weight, though seed yield differences may not always be significant (Singh *et al.*, 2011) [11].

Weed management in mungbean requires integrated approaches. Pre- and post-emergence herbicides such as pendimethalin, propaquizafop, imazethapyr, cycloxydim, and quizalofop-ethyl have shown effectiveness against annual grasses and broadleaf weeds. However, integrated weed management, combining chemical and cultural practices, is considered more sustainable.

Materials and Methods

The field experiment was conducted at the Crop Research Center (CRC) main campus of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut (U.P.), located at a latitude of 29° 4' North and longitude of 77° 42' East with an elevation of 237 meter above the mean sea level. Meerut is located on the Delhi- Dehradun national highway road 800 m away from experimental site. The experiment was laid out in Split Plot Design (SPD) with three replications three in main plot and four in sub-plot. There were 12 treatment combination replicated thrice. The factors are Main plot: (Planting techniques) Flat bed without residue, Furrow planting without residue, Furrow planting with Residue, Sub plot: (Weed management practice) Weedy check, Weed free (2 Hand Weeding) 20 and 40 DAS, Pendimethalin 1kg/ha (PE) fb fluazifop-p-butyl 150 g/ha (PoE) at 15 DAS, Propaquizafop 75 g/ha (PoE) at 15 DAS. Mungbean variety (*Samrat*) was selected for sowing. Seed were sown in line manually. Seeds were covered with soil immediately after sowing. The mungbean crop was sown on 24 July 2024. Harvesting was done by taking 1 m² area from each. And from it five plants were randomly selected for recording growth and yield parameters. The observations were recorded for Weed population, Weed biomass, Weed control efficiency (%), Nutrient uptake by weeds, Plant population, plant height, Number of trifoliate leaves/plant, Number of branches/plant, Leaf area index (LAI), dry weight, crop growth rate, Days taken to flowering (50%), Days taken to maturity, Number of pods/plant, Number of grains/pod, Pod length (cm), test weight, Biological yield (kg/ha), grain yield, straw yield, harvest index. The data was subjected to statistical analysis by analysis of variance method. Economics was calculated viz., cost of cultivation, gross return, net return, benefit cost ratio were calculated.

Results and Discussion

Weeds parameters

Weed biomass of weed (gm⁻²): In planting techniques, furrow planting with residues recorded minimum dry biomass of weeds

(3.75 g m⁻²) over furrow planting without residues at 25 DAS.

The present study demonstrated that maintaining weed-free conditions, specifically by hand weeding at 20 and 40 DAS, significantly reduced weed dry biomass when compared to alternative weed management practices. Pre-emergence application of pendimethalin (1kg/ha) fb fluazifop-p-butyl 150g/ha at 15 DAS recorded significantly lowest dry biomass of weed (4.15gm⁻²) over propaquizafop 75g/ha (PoE) is 4.26 at 25 DAS respectively. Significantly highest dry biomass of weed was recorded under weedy check at all the stage 25, 50 DAS and at harvest respectively.

Weed control efficiency (%): Maximum weed control efficiency (58.24%) was recorded under furrow planting with residues planting recorded as compare to furrow planting without residue at harvest.

Among the available methods for managing weeds, the implementation of pendimethalin 1kg/ha (PE) fb fluazifop-p-butyl 150g/ha at 15 DAS recorded significantly highest weed control efficiency (67.04%) as compare to propaquizafop 75g/ha (PoE) is 63.42 at harvest respectively. Highest weed control efficiency (100%) was recorded under weed free (HW at 20 and 40 DAS) at all the stage 25, 50 DAS at harvest.

In terms of weed control efficiency (WCE), the sequential application of Pendimethalin followed by Fluazifop-p-butyl at 15 DAS showed the highest value among the various weed management treatments. As expected, the weed-free treatment (hand weeding at 20 and 40 DAS) achieved the highest weed control efficiency because no weeds were present in these plots. Conversely, the weedy check exhibited the lowest weed control efficiency. These results are consistent with observations reported by Kumar and Kundra (2001) [18], Kumar *et al.* (2006) [2], and Kundu *et al.* (2009) [20].

Total weed density (m⁻²): The data associated to density of total weed as influenced by Planting techniques and weed management practices significantly influenced the density of total weed. Furrow planting with residues resulted significantly lowest density of total weed over furrow planting without residues is 8.75, 9.00 and 9.27 at 25DAS, 50 DAS and at harvest respectively.

Among the available methods for managing weeds, the implementation of Pendimethalin 1kg/ha (PE) fb fluazifop-p-butyl 150g/ha (PoE) at 15DAS recorded significantly lowest density of total weed 7.59 as compare to Propaquizafop 75g/ha (PoE) is 8.86 respectively. None of the weed management practice proved superiority over weed free (HW at 20 and 40 DAS) recorded significantly lowest density of total weed. Significantly highest density of total weed was recorded under weedy check at all the stage of 25, 50 DAS and harvest respectively.

Crop growths parameters

Plant population (no. m⁻²): In planting techniques, furrow planting with residues recorded significantly maximum plant population over furrow planting without residues.

Weed free (HW at 20 and 40 DAS) recorded significantly maximum over other weed management practices under present investigation. Pre-emergence application of pendimethalin (1kg/ha) fb fluazifop-p-butyl 150g/ha at 15DAS recorded significantly maximum plant population (23.42m⁻²) over propaquizafop 75g/ha (PoE) 22.55 at 25 DAS respectively. Significantly highest dry biomass of weed was recorded under weedy check at all the stage 25, 50 DAS at harvest respectively.

Plant Height (cm): In planting methods, furrow planting with residues recorded significantly taller plant (58.65cm) as compare to furrow planting without residues at all stages of observations. Among the available methods for managing weeds, the implementation of Pendimethalin 1kg/ha (PE) fb fluazifop-p-butyl 150g/ha (PoE) at 15 DAS recorded significantly taller plant 59.90cm as compare to Propaquizafop 75g/ha (PoE) is (56.80cm) at harvest respectively.

Number of leaves Plant⁻¹: Among the available methods for managing weeds, the implementation of Pendimethalin 1kg/ha (PE) fb fluazifop-p-butyl 150g/ha (PoE) at 15 DAS recorded significantly maximum number of leaves (40.23), as compare to Propaquizafop 75g/ha (PoE) is 39.12 at 50 DAS respectively. None of the weed management practice proved superiority over weed free (HW at 20 and 40 DAS) with respect to plant height. Significantly shortest plant was recorded under weedy check at all the stage 25, 50 DAS at harvest respectively.

Dry weight (g plant⁻¹): The data associated to plant dry matter at various stages of crop growth In planting techniques, furrow planting with residues recorded maximum plant dry matter accumulation over furrow planting without residues at all stages of crop growth.

Pre-emergence application of Pendimethalin 1kg/ha (PE) fb fluazifop-p-butyl 150g/ha (PoE) at 15 DAS recorded maximum plant dry matter accumulation 14.70 g plant⁻¹ over to Propaquizafop 75g/ha (PoE) is 14.48 gplant⁻¹ at harvest respectively. Significantly highest plant dry matter accumulation recorded under weed free (HW at 20 and 40 DAS). Significantly lowest plant dry matter accumulation was recorded under weedy check at all the stage 25, 50 DAS at harvest respectively.

Days taken to flowering (50%): Pre-emergence application of Pendimethalin 1kg/ha (PE) fb fluazifop-p-butyl 150g/ha (PoE) at 15DAS recorded maximum flowering 45.91 as compare to Propaquizafop 75g/ha (PoE) is 45.62 respectively. Significantly highest flowering recorded under weed free (HW at 20 and 40 DAS) and lowest flowering was recorded under weedy check flowering recorded under weed free (HW at 20 and 40 DAS) and lowest flowering was recorded under weedy check

Days taken to maturity: In planting techniques, furrow planting with residues recorded significantly higher flowering 82.84 over furrow planting without residues at maturity.

Pre-emergence application of Pendimethalin 1kg/ha (PE) fb fluazifop-p-butyl 150g/ha (PoE) at 15DAS recorded significantly highest flowering 82.92 as compare to Propaquizafop 75g/ha (PoE) at 15 DAS is 81.99 respectively.

No. of pods plant⁻¹: Pre-emergence application of Pendimethalin 1kg/ha (PE) fb fluazifop-p-butyl 150g/ha (PoE) at 15 DAS recorded significantly highest pod 22.40 as compare to Propaquizafop 75g/ha (PoE) at 15 DAS is 21.63 respectively. Significantly highest pod recorded under weed free (HW at 20 and 40 DAS) and lowest pod in weedy check.

However, none of the herbicide treatments or individual hand weeding applications surpassed the effectiveness of the completely weed-free treatment, achieved by manual weeding at 20 and 40 DAS, which consistently resulted in the highest values for the aforementioned growth parameters. These findings are consistent with the research of Khaliq *et al.* (2002) [12], Khan *et al.* (2004) [13], Sheoran *et al.* (2006) [14], Deore *et al.* (2008) [15], Faida *et al.* (2009) [16], and Singh *et al.* (2014) [17], all of whom

have reported similar positive impacts of effective weed management on crop growth and development.

Yield attributes and Yield

Number of grains pod⁻¹: In planting techniques, furrow planting with residues has maximum grain (6.32) over furrow planting without residues.

Pre-emergence application of Pendimethalin 1kg/ha (PE) fb fluazifop-p-butyl 150g/ha (PoE) at 15 DAS recorded maximum grain 6.22 as compare to Propaquizafop 75g/ha (PoE) at 15 DAS is 6.20, respectively. Maximum grain recorded under weed free (HW at 20 and 40 DAS) and lowest grain was recorded in weedy check

Pod length (cm): In planting techniques, furrow planting with residues recorded maximum pod length 7.08cm over furrow planting without residues.

Pre-emergence application of Pendimethalin 1kg/ha (PE) fb fluazifop-p-butyl 150g/ha (PoE) at 15 DAS recorded significantly highest pod length 6.98 cm as compare to Propaquizafop 75g/ha (PoE) at 15 DAS is 6.64 respectively. Significantly highest pod length observed under weed free (HW at 20 and 40 DAS) and lowest pod length was recorded in weedy check

Test Weight (g): In planting techniques, furrow planting with residues observed maximum test weight (34.77gm) over furrow planting without residues at all stages of crop growth.

Grain yield (kg ha⁻¹): Furrow planting with residues observed maximum grain yield 955.72 kg ha⁻¹ over furrow planting without residues. Among weed management practices, Pendimethalin 1kg/ha (PE) fb fluazifop-p-butyl 150g/ha (PoE) application of 15DAS observed maximum grain yield (960.82kg ha⁻¹) as compare to Propaquizafop 75g/ha (PoE) 832.23 kg ha⁻¹ respectively. None of the weed management practice proved superiority over weed free (HW at 20 and 40 DAS) observed maximum grain yield (963.44 kg ha⁻¹) and lowest grain yield (732.2kg ha⁻¹) was recorded in weedy check.

Straw Yield (kg/ha): Furrow planting with residues observed maximum straw yield 2703.90kg ha⁻¹ over furrow planting without residues. Among weed management practices, Pendimethalin 1kg/ha (PE) fb fluazifop-p-butyl 150g/ha (PoE) application observed maximum straw yield 2704.07(kg ha⁻¹) as compare to Propaquizafop 75g/ (PoE) 2369.07 kg ha⁻¹ respectively. None of the weed management practice proved superiority over weed free (HW at 20 and 40 DAS) recorded maximum straw yield (2710.59 kg ha⁻¹) and lowest grain yield (1715.14kg ha⁻¹) was recorded in weedy check.

Biological yield: Furrow planting with residues observed maximum biological yield 3658.89 kg ha⁻¹ over furrow planting without residues. Among weed management practices, Pendimethalin 1kg/ha (PE) fb fluazifop-p-butyl 150g/ha (PoE) application observed maximum biological yield 3665.72 (kg ha⁻¹) as compare to Propaquizafop 75g/ha (PoE) 3201.30kg ha⁻¹ respectively. None of the weed management practice proved superiority over weed free (HW at 20 and 40 DAS) recorded maximum yield (3674.03kg ha⁻¹) and lowest grain yield (2247.54kg ha⁻¹) was recorded in weedy check.

Harvest index (%): Furrow planting with residues recorded significantly higher harvest index 26.12 over furrow planting

without residues. Among weed management practices, Pendimethalin 1kg/ha (PE) fb fluazifop-p-butyl 150g/ha (PoE) application recorded significantly highest 26.19 as compare to Propaquizafop 75g/ha (PoE) 25.99 respectively. None of the weed management practice proved superiority over weed free (HW at 20 and 40 DAS) recorded significantly highest harvest index 26.21 and lowest harvest index 25.98 was recorded under weedy check.

Among the chemical weed management approaches, the sequential application of Pendimethalin (1kg/ha) as a pre-emergence treatment followed by Fluazifop-p-butyl (150g/ha) as a post-emergence treatment at 15 DAS resulted in significantly higher grain, straw, and biological yields compared to using only Propaquizafop (75g/ha) post-emergence at 15 DAS. The substantial increases in grain and straw yield observed under effective weed management can be directly attributed to the significant improvements in yield attributes (like the number of pods and grains, and grain weight) previously discussed. [3] The reduced competition between the crop and weeds, brought about by these management practices, fostered superior vegetative

growth and yield components, which ultimately led to higher grain and straw production. These findings are supported by similar observations reported by Dungarwal *et al.* (2003) ^[1], Sheoran *et al.* (2006) ^[10], Singh *et al.* (2011) ^[11], Singh *et al.* (2013), Mirjha *et al.* (2013) ^[22], and Singh *et al.* (2014) ^[17].

Economic analysis: Furrow planting with residues resulted higher gross and net return over furrow planting without residues. This might be due to better grain and straw yield under furrow planting with residues. Similar result also reported by Upadhyay *et al.* (2001) and Bhakte *et al.* (2006).

However, the "weed-free" situation, achieved through manual weeding at 20 and 40 DAS, resulted in the highest gross and net returns among all weed management options. This superior profitability under weed-free conditions is a direct consequence of achieving the highest grain and straw yields of mungbean. These findings are consistent with previous research by Kohli *et al.* (2006), Deore *et al.* (2007) ^[15], and Yadav *et al.* (2009) ^[5], who also reported similar positive impacts of effective weed control on economic returns.

Table 1: Effect of planting techniques and weed management practices on weed parameters

Treatments	Weed biomass of weed (gm ⁻²)	Total weed density (m ⁻²)	Weed control efficiency (%)
A.Planting techniques			
Flat bed without residue	4.34 (18.33)	10.22 (104.0)	53.63
Furrow planting without residue	4.20 (17.14)	9.75 (94.48)	60.99
Furrow planting with Residue	3.90 (14.71)	9.27 (85.49)	58.24
S. Em. (±)	0.612	0.419	0.535
C.D. at 5%	1.530	1.046	1.337
A. Weed management practice			
Weedy check	6.18 (37.87)	14.98 (224.04)	0.01
Weed free (2 HW) 20 and 40 DAS	1.00 (0.00)	1.00 (0.00)	100.00
Pendimethalin 1kg/ha (PE) fb fluazifop-p-butyl 150g/ha (PoE) at 15 DAS	3.56 (12.18)	8.21 (66.87)	67.04
Propaquizafop 75g/ha (PoE) at 15 DAS	4.16 (16.84)	9.39 (87.73)	63.42
S. Em. (±)	0.276	0.275	0.268
C.D. at 5%	1.105	1.102	1.074

Table 2: Effect of planting techniques and weed management practices on growth parameters at harvest in kharif planted mungbean

Treatments	Plant population (no. m ⁻²)	Plant height (cm plant ⁻¹)	Number of leaves Plant ⁻¹	Dry weight (g plant ⁻¹)
A. Planting techniques				
Flat bed without residue	18.60	56.37	27.09	13.09
Furrow planting without residue	20.11	56.39	28.66	13.18
Furrow planting with Residue	20.33	58.65	28.89	13.77
S. Em. (±)	0.405	0.733	0.231	0.232
C.D. at 5%	1.013	1.832	0.577	0.580
B. Weed management practice				
Weedy check	16.27	51.85	16.43	9.74
Weed free (2 HW) 20 and 40 DAS	21.38	59.90	32.99	14.73
Pendimethalin 1kg/ha (PE) fb fluazifop-p-butyl 150g/ha (PoE) at 15 DAS	20.78	59.80	31.27	14.70
Propaquizafop 75g/ha (PoE) at 15 DAS	19.80	56.75	30.16	14.48
S. Em. (±)	0.216	0.251	0.159	0.065
C.D. at 5%	0.863	1.004	0.635	0.262

Table 3: Effect of planting techniques and weed management practices on days taken to flowering (50%), days taken to maturity and number of pods plant⁻¹ in kharif planted mungbean

Treatments	Days taken to flowering (50%)	Days taken to maturity	No. of pods plant ⁻¹
A. Planting techniques			
Flat bed without residue	45.08	81.41	21.90
Furrow planting without residue	46.55	82.21	22.05
Furrow planting with Residue	47.90	82.84	22.43
S. Em. (±)	0.490	0.352	0.102
C.D. at 5%	1.223	0.879	0.254
B. Weed management practice			
Weedy check	47.13	81.42	21.22
Weed free (2 HW)20 and 40 DAS	44.69	83.22	22.86
Pendimethalin 1kg/ha (PE) fb fluazifop-p-butyl 150g/ha (PoE) at 15 DAS	45.91	82.92	22.40
Propaquizafop 75g/ha (PoE) at 15 DAS	45.62	81.99	21.63
S. Em. (±)	0.306	0.193	0.065
C.D. at 5%	1.226	0.770	0.258

Table 4: Effect of planting techniques and weed management practices on number of grain pod⁻¹, pod length(cm) and test weight in kharif planted mungbean

Treatments	Number of grains pod ⁻¹	Pod length (cm)	Test weight(g)
A. Planting techniques			
Flat bed without residue	6.16	6.55	33.99
Furrow planting without residue	6.17	6.74	34.43
Furrow planting with Residue	6.32	7.08	34.77
S. Em. (±)	0.038	0.038	0.363
C.D. at 5%	0.094	0.094	0.908
B. Weed management practice			
Weedy check	6.05	6.38	33.74
Weed free (2 HW)20 and 40 DAS	6.38	7.14	34.83
Pendimethalin 1kg/ha (PE) fb fluazifop-p-butyl 150g/ha (PoE) at 15 DAS	6.22	6.98	34.67
Propaquizafop 75g/ha (PoE) at 15 DAS	6.20	6.64	34.33
S. Em. (±)	0.020	0.020	0.166
C.D. at 5%	0.081	0.081	0.663

Table 5: Effect of planting techniques and weed management practices on grain yield, straw yield, biological yield (kg ha⁻¹) and harvest index (%) in kharif planted mungbean

Treatments	Grain yield (kg ha ⁻¹)	Straw yield (kg ha ⁻¹)	Biological yield (kg ha ⁻¹)	Harvest index (%)
A. Planting techniques				
Flat bed without residue	833.19	2368.67	3201.86	25.97
Furrow planting without residue	851.26	2420.19	3271.44	26.04
Furrow planting with Residue	955.72	2703.17	3658.89	26.12
S. Ed. (±)	31.18	84.90	116.08	0.045
C.D. at 5%	NS	NS	NS	NS
B. Weed management practice				
Weedy check	732.41	1715.14	2247.54	25.98
Weed free (2 HW)20 and 40 DAS	963.44	2710.59	3674.03	26.21
Pendimethalin 1kg/ha (PE) fb fluazifop-p-butyl 150g/ha (PoE) at 15 DAS	960.82	2704.90	3665.72	26.19
Propaquizafop 75g/ha (PoE) at 15 DAS	832.23	2369.07	3201.30	25.99
S. Ed. (±)	48.29	202.62	290.34	0.05
C.D. at 5%	NS	NS	NS	NS

Table 6: Effect of planting methods and weed management practices on Cost of cultivation, Gross return, Net return and B: C ratio

Treatment	Cost of cultivation (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C ratio
A. Planting Techniques				
Flat bed without residue	19132.66	56525.35	37393.35	2.95
Furrow planting without residue	20197.14	57752.09	37554.95	2.85
Furrow planting with Residue	22324.64	64924.97	42600.33	2.90
S. Em. (±)	766.14	2138.78	1395.69	0.02
C.D. at 5%	NS	NS	NS	0.06
B. Weed Management Practice				
Weedy check	17819.16	49321.79	31502.63	2.76
Weed free	23276.66	65334.19	42057.53	2.80
Pendimethalin 1kg/ha (PE) fb fluazifop-p-butyl 150g/ha (PoE) at 15 DAS	22914.16	65334.20	42420.04	2.85
Propaquizafop 75g/ha (PoE) at 15 DAS	22930.06	56464.02	33533.96	2.46
S. Em. (±)	1132.73	3356.82	2457.35	0.08
C.D. at 5%	NS	NS	NS	0.16

Conclusion

Based on the summarized findings, combining furrow planting with residues and a specific herbicide application (pre-emergence Pendimethalin at 1kg/ha followed by post-emergence Fluazifop-p-butyl at 150g/ha at 15 DAS) is the most profitable recommendation for cultivating mungbean. This approach yielded the maximum net returns and benefit:cost ratio compared to other tested weed management practices. The effectiveness is attributed to the reduced weed competition provided by the furrow planting system and the herbicide combination, which optimized crop growth, yield attributes, NPK uptake, and ultimately, profitability. While a completely weed-free environment (achieved through hand weeding) showed the highest biological returns, the herbicide combination offers a more practical and economical alternative for farmers, especially considering the challenges of labor availability and costs associated with extensive manual weeding.

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