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Effect of Weed Management Practices on Yield Attributes, Yield and Weed Density of Mungbean (*Vigna radiate* L.) in *Vertisol* of Chhattisgarh Plains

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted at Instructional cum Research Farm, Indira Gandhi Krishi VisHand weedingavidyalaya, Raipur (C.G.) during *mansoon crop* 2021 and 2022. The soil of experimental field was neutral in reaction, medium in organic carbon and low in available nitrogen,

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low in available phosphorus and high in available potassium. Experiment was laid out in randomized block design with three replications, consisted of T1-Imazethapyr 10 % SL (Dose-55 g a.i. ha^{-1}), T2- Fluazifop-p-butyl 13.4% w w^{-1} (Dose-250 g a.i. ha^{-1}), T3-Propaquizafop 2.5% w w^{-1} (weight per weight) + imazethapyr 3.75 % w w^{-1} ME (ready mix) (Dose-83.3g a.i. ha^{-1}), T4-Acifluorfen-sodium 16.5% EC + clodinafop-propargyl 8% EC (ready mix) (Dose-210 g a.i. ha^{-1}), T5-Fomesafen 11.1% w w^{-1} + fluazifop-p-butyl 11.1% w w^{-1} (ready mix) (Dose-440 g a.i. ha^{-1}), T6-Hand weeding twice at 20 and 40 DAS (Days after sowing) , T7- Weed free (Hand weeding at 20, 40 and 60 DAS) and T8- Unweeded check.

The weeds of the experimental site was dominated with grasses like *Echinochloacolona, Dinebraretroflexa,* broad leaves like *Parthenium hysterophorus, Celosia argentea,* sedge like *Cyperus* sps. and other weeds. Results revealed that all the yield attributes and yield was highest in fomesafen 11.1% w w^{-1} + fluazifop-p-butyl 11.1% w w^{-1} (ready mix) (Dose-440 g a.i. ha^{-1}) (T5) which was at par with propaquizafop 2.5% w w^{-1} + imazethapyr 3.75 % w w^{-1} ME (ready mix) (Dose-83.3g a.i. ha^{-1})(T3) and acifluorfen-sodium 16.5% EC + clodinafop-propargyl 8% EC (ready mix) (Dose-210 g a.i. ha^{-1})(T4). Similar ways, weed density was also significantly reduced in these treatments to others. However, higher WCE (Weed control efficiency) was noticed in this treatment than unweeded check.

Keywords: Fomesafen; fluazifop-p-butyl; mungbean; weed density and Weed Control Effcicency (WCE); weed index.

1. INTRODUCTION

Mungbean (*Vigna radiate* L.) is a protein (25-27%) rich legume crop. The mungbean, alternatively known as the greengram and mung. It is originated from the Indian subcontinent and belongs to legume family. The mungbean is mainly cultivated in East, Southeast and South Asia. It can be grown in all the seasons of the year as seed crop as fodder crop also. It helps to soil building which fixes atmospheric nitrogen through symbiotic action. Mungbean utilizes limited soil water and nutrients very efficiently than cereal crops. Weeds cause severe yield losses in mungbean due to its small stature. Weeds compete with the resources like nutrient, water and light. High temperature and frequent rains during crop period infest the crop heavily with weeds which negatively affect the productivity of crop. Generally, weed control in mungbean is done by physical methods like hand weeding. Generally, 2-3 hand weedingare required to keep the crop weed free. Hand weedingis costly because it is not only time consuming but labour intensive also. But, with the increasing crisis of labour, exploring the possibility of herbicidal weed control in mungbean requires attention. Therefore, the study of chemical weed management importance in mungbean. In this experiment, fomesafen 11.1 % w w^{-1} + fluazifop-p-butyl 11.1% w w^{-1} (ready mix) (Dose-440 g a.i. ha^{-1}) (T5) found more effective than other given herbicides.

2. MATERIALS AND METHODS

The study was carried out at Instructional cum Research Farm, Indira Gandhi Krishi VisHand weedingavidyalaya, Raipur (C.G.) during mansoon crop2021 and 2022. The soil of experimental field was *Vertisols*. Experiment was conducted in randomized block design with three replications, consisted of T1-Imazethapyr 10 % SL (Dose-55 g a.i. ha^{-1}), T2- Fluazifop-p-butyl 13.4% w w^{-1} (Dose-250 g a.i. ha^{-1}), T3-Propaquizafop 2.5% w w^{-1} + imazethapyr 3.75 % w w^{-1} ME (ready mix) (Dose-83.3g a.i. ha^{-1}), T4-Acifluorfen-sodium 16.5% EC + clodinafop-propargyl 8% EC (ready mix) (Dose-210 g a.i. ha^{-1}), T5- Fomesafen 11.1% w w^{-1} + fluazifop-p-butyl 11.1% w w^{-1} (ready mix) (Dose-440 g a.i. ha^{-1}), T6-Hand weeding twice at 20 and 40 DAS, T7- Weed free (Hand weeding at 20, 40 and 60 DAS) and T8- Unweeded check. Yield attributes as well as and seed yields and stover yield were recorded at harvest of the crop. Number of weeds (grasses, broad leaf weeds and sedges) was counted at 20, 40, 60 DAS and at harvest. Weed control efficiency was calculated by the formulae suggested by Mani et al. (1973).

$$\text{WCE (\%)} = \frac{WP_c - WP_t}{WP_c} x100$$

Where,

WCE = Weed control efficiency (%)
WP_C = Weed population in unweeded control (m^{-2})

WPt = Weed population in treated plot (m^{-2})

Weed index shows the per cent reduction in crop yield under a particular treatment due to the presence of weeds in comparison to weed free plot as suggested by Gill and Kumar (1969). This is used to assess the efficacy of an herbicide. Lesser the weed index, better is the efficiency of a herbicide. It is expressed in percentage and was determined with the help of following formula:

$$WI\ (\%) = \frac{X-Y}{X} x100$$

Where,

WI = Weed index (%)
X = Crop yield from weed free plot (Hand weedingtwice at 20 and 40 DAS)
Y = Crop yield from the treated plot for which weed index is to be worked out

The data obtained on yield attributes, yield and weed density were tabulated and subjected randomized block design to statistical analysis. The data on weed density was subjected to square root transformation i.e. before carrying analysis of variance. The levels of treatment were tested with 'F' test showing their significance, the levels of treatment were compared by critical difference at 5% level of probability (Gomez and Gomez, 1984).

3. RESULTS AND DISCUSSION

3.1 Yield Attributes and Yield

Yield attributes and yield as well as seed yield and stover yield were significantly influenced by different weed management practices. Moreover, treatments the yield attributing characters like number of seeds pod^{-1},pod length and seed index showed no significant difference because the crop variety is same which was used in this experiment. The number of pods $plant^{-1}$ found significantly higher in fomesafen 11.1 % w w^{-1} + fluazifop-p-butyl 11.1% w w^{-1} (ready mix) (Dose-440 g a.i. ha^{-1}) (T5) (16.77, 17.10 and 16.93 in year 2021, 2022 and mean, respectively) (Table 1) which was found at par with propaquizafop 2.5% w w^{-1} + imazethapyr 3.75 % w w^{-1} ME (ready mix) (Dose-83.3g a.i.ha^{-1})(T3) and acifluorfen-sodium 16.5% EC + clodinafop-propargyl 8% EC (ready mix) (Dose-210 g a.i. ha^{-1})(T4). Moreover, weed free (T7) (20.67, 23.33 22.00 in year 2021, 2022 and mean, respectively) has proved to be the best to number of pods $plant^{-1}$followed by Hand weeding twice at 20 and 40 DAS (T6) while, unweeded check (T8) (14.00, 13.67 and 13.83 in year 2021, 2022 and mean, respectively) resulted in the lowest number of pods $plant^{-1}$. The maximum yield in herbicidal treatment might be due, lower weed density and higher weed control efficiency which made more availability of plant spaces and lower competition to crop plant for light, water, nutrient and necessary resources that gave more photosynthesis formation in source which translocate and accumulate in sink which gave higher yield attributing characters i. e. number of pods $plant^{-1}$. These results corroborate the findings of Kumar et al. (2016), Rupareliya et al. (2018) and Mishra et al. (2024).

3.2 Weed Flora

The weed observed in the experimental field mainly comprised of grasses like *Echinocloacolona, Dinebraretroflexa,* broad leaf like *Parthenium hysterophorus, Celosia argentea,* sedges like *Cyperus* sps. and others.

At 20 DAS there was no significant difference among all the treatments for total weed density production because herbicide was not applied at that time. At 40, 60 DAS and at harvest the significant reduction in total weed density production was recorded (34.10, 62.93 and 65.25 no. m^{-2}on mean basis) (Table 3) in herbicide application fomesafen 11.1% w w^{-1} + fluazifop-p-butyl 11.1% w w^{-1} (ready mix) (Dose-440 g a.i. ha^{-1}) (T5) which was followed by propaquizafop2.5% w w^{-1} + imazethapyr 3.75 % w w^{-1} ME (ready mix) (Dose-83.3g a.i. ha^{-1}) (T3) and acifluorfen-sodium 16.5% EC + clodinafop-propargyl 8% EC (ready mix) (Dose-210 g a.i. ha^{-1})(T4). Moreover, weed free (T7) recorded minimum total weed density production followed by Hand weedingtwice at 20 and 40 DAS (T6) while, unweeded check (T8) resulted maximum total weed density production. The lower weed density under herbicidal treatments due to the more detrimental effect of the herbicides for the control of weed flora. Almost similar results were also observed by Singh et al. (2014), Kumar and Chinnamuthu (2014), Punia et al. (2015) and Gelot et al. (2018).

Table 1. Effect of different herbicides on yield attributes of mungbean

Treatment	No. of pods plant^{-1}			No. of seed pod^{-1}			Seed index (g)			Pod length (cm)		
	2021	2022	Mean	2021	2022	Mean	2021	2022	Mean	2021	2022	Mean
T1	14.70	15.37	15.03	10.73	10.80	10.77	5.33	6.47	5.63	5.40	5.43	5.42
T2	14.33	14.67	14.50	10.33	10.67	10.50	5.23	5.93	5.38	5.37	5.40	5.38
T3	16.70	17.00	16.85	11.48	11.61	11.55	5.50	5.53	5.75	5.53	5.57	5.55
T4	16.60	16.93	16.77	11.30	11.33	11.32	5.33	6.00	5.50	5.47	5.50	5.48
T5	16.77	17.10	16.93	11.66	11.86	11.76	5.53	5.67	5.60	5.57	5.60	5.58
T6	17.07	17.40	17.23	11.87	11.90	11.88	5.63	5.67	5.85	5.83	5.90	5.87
T7	20.67	23.33	22.00	11.91	11.97	11.94	5.80	6.07	6.03	5.90	5.93	5.92
T8	14.00	13.67	13.83	9.66	9.56	9.61	5.07	6.27	5.67	4.87	4.93	4.90
SEm±	**0.62**	**0.50**	**0.56**	**0.63**	**0.59**	**0.60**	**0.39**	**0.29**	**0.24**	**0.39**	**0.38**	**0.39**
CD (P=0.05)	**1.88**	**1.53**	**1.69**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

T1-Imazethapyr 10 % SL (Dose-55 g a.i. ha^{-1}); T2- Fluazifop-p-butyl 13.4% w w^{-1} (Dose-250 g a.i. ha^{-1}); T3-Propaquizafop 2.5% w w^{-1} + Imazethapyr 3.75 % w w^{-1} ME (ready mix) (Dose-83.3g a.i. ha^{-1}); T4- Acifluorfen-sodium 16.5% EC + Clodinafop-propargyl 8% EC (ready mix) (Dose-210 g a.i. ha^{-1}); T5- Fomesafen 11.1% w w^{-1} + Fluazifop-p-butyl 11.1% w w^{-1} (ready mix) (Dose-440 g a.i. ha^{-1}); T6-Hand weedingtwice at 20 and 40 DAS; T7- Weed free (HAND WEEDINGat 20, 40 and 60 DAS); T8- Unweeded check

Table 2. Effect of different herbicides on yields of mungbean

Treatment	Seed yield(Kg ha^{-1})			Stover yield(kg ha^{-1})			Weed index(%)		
	2021	2022	Mean	2021	2022	Mean	2021	2022	Mean
T1	602	685	644	1200	1274	1237	38.0	30.7	34.3
T2	567	570	568	1165	1233	1199	41.6	42.3	42.0
T3	743	770	757	1363	1380	1372	23.4	22.1	22.7
T4	720	740	730	1328	1343	1336	25.8	25.1	25.4
T5	772	810	791	1372	1447	1409	20.4	18.0	19.2
T6	850	878	864	1383	1450	1417	12.4	11.1	11.7
T7	970	988	979	1570	1633	1602	0.0	0.0	0.0
T8	467	433	450	1037	867	952	51.9	56.2	54.0
SEm±	**38**	**30**	**34**	**57**	**55**	**56**	**-**	**-**	**-**
CD (P=0.05)	**116**	**90**	**102**	**171**	**165**	**169**	**-**	**-**	**-**

Table 3.Effect of different herbicides on total weed density (g m^{-2}) in different time interval in mungbean

Treatment	Total weed density (Number m^{-2})											
	20DAS			40 DAS			60DAS			At harvest		
	2021	2022	Mean	2021	2022	Mean	2021	2022	Mean	2021	2022	Mean
T1	**10.25** (104.52)	**9.56** (90.84)	**9.90** (97.56)	**9.07** (81.79)	**8.04** (64.18)	**8.56** (72.72)	**10.60** (111.83)	**9.74** (94.35)	**10.17** (102.91)	**10.86** (117.46)	**10.22** (104.03)	**10.54** (110.64)
T2	**9.78** (95.24)	**9.72** (93.98)	**9.75** (94.61)	**9.59** (91.53)	**9.62** (92.14)	**9.61** (91.84)	**11.49** (131.47)	**11.30** (127.21)	**11.39** (129.33)	**11.85** (139.97)	**11.47** (131.03)	**11.66** (135.46)
T3	**9.32** (86.27)	**8.76** (76.29)	**9.04** (81.20)	**7.14** (50.42)	**6.08** (36.44)	**6.61** (43.15)	**8.32** (68.67)	**8.77** (76.43)	**8.54** (72.50)	**8.60** (73.54)	**8.78** (76.67)	**8.69** (75.10)
T4	**9.30** (86.06)	**8.86** (78.00)	**9.08** (81.98)	**7.47** (55.36)	**7.22** (51.65)	**7.35** (53.49)	**8.77** (76.44)	**9.02** (80.88)	**8.90** (78.64)	**9.03** (81.04)	**9.41** (88.10)	**9.22** (84.53)
T5	**9.14** (83.11)	**8.74** (75.96)	**8.94** (79.50)	**6.49** (41.61)	**5.27** (27.33)	**5.88** (34.10)	**7.86** (61.21)	**8.07** (64.66)	**7.96** (62.93)	**7.97** (63.00)	**8.25** (67.53)	**8.11** (65.25)
T6	**9.73** (94.26)	**8.97** (80.02)	**9.35** (86.99)	**3.92** (14.85)	**3.27** (10.20)	**3.59** (12.42)	**3.58** (12.33)	**2.92** (8.00)	**3.25** (10.05)	**4.33** (18.24)	**3.66** (12.93)	**4.00** (15.48)
T7	**9.86** (96.65)	**8.84** (77.70)	**9.35** (86.92)	**0.71** (0.00)	**0.71** (0.00)	**0.71** (0.00)	**0.71** (0.00)	**0.71** (0.00)	**0.71** (0.00)	**0.71** (0.00)	**0.71** (0.00)	**0.71** (0.00)
T8	**9.42** (88.30)	**10.12** (101.87)	**9.77** (94.97)	**11.11** (122.83)	**12.41** (153.42)	**11.76** (137.70)	**12.88** (165.29)	**13.77** (189.23)	**13.33** (177.06)	**13.61** (184.67)	**14.14** (199.56)	**13.88** (192.04)
SEm±	**0.24**	**0.25**	**0.25**	**0.19**	**0.16**	**0.17**	**0.23**	**0.18**	**0.20**	**0.29**	**0.31**	**0.30**
CD (P=0.05)	**NS**	**NS**	**NS**	**0.57**	**0.48**	**0.52**	**0.69**	**0.55**	**0.61**	**0.89**	**0.93**	**0.90**

Figures in parenthesis are the original values. Data transformed to square root transformation $\sqrt{X+0.5}$ are in bold letters

T1-Imazethapyr 10 % SL (Dose-55 g a.i. ha^{-1}); T2- Fluazifop-p-butyl 13.4% w w^{-1} (Dose-250 g a.i. ha^{-1}); T3-Propaquizafop 2.5% w w^{-1} + Imazethapyr 3.75 % w w^{-1} ME (ready mix) (Dose-83.3g a.i. ha^{-1}); T4- Acifluorfen-sodium 16.5% EC + Clodinafop-propargyl 8% EC (ready mix) (Dose-210 g a.i. ha^{-1}); T5- Fomesafen 11.1% w w^{-1} + Fluazifop-p-butyl 11.1% w w^{-1} (ready mix) (Dose-440 g a.i. ha^{-1}); T6-Hand weedingtwice at 20 and 40 DAS; T7- Weed free (HAND WEEDINGat 20, 40 and 60 DAS); T8- Unweeded check

Table 4. Effect of different herbicides on weed control efficiency (%) in different time intervals in mungbean

Treatment	Weed control efficiency (%)								
	40 DAS			60 DAS			At harvest		
	2021	2022	Mean	2021	2022	Mean	2021	2022	
T1	33.4	58.2	47.2	32.3	50.1	41.9	36.4	47.9	42.4
T2	25.5	39.9	33.3	20.5	32.8	27.0	24.2	34.3	29.5
T3	59.0	76.2	68.7	58.5	59.6	59.1	60.2	61.6	60.9
T4	54.9	66.3	61.2	55.6	57.3	56.5	58.2	55.9	57.0
T5	66.1	82.2	75.2	63.0	65.8	64.5	65.9	66.2	66.0
T6	87.9	93.4	91.0	92.5	95.8	94.3	90.1	88.4	89.3
T7	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
T8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

T1-Imazethapyr 10 % SL (Dose-55 g a.i. ha^{-1}); T2- Fluazifop-p-butyl 13.4% w w^{-1} (Dose-250 g a.i. ha^{-1}); T3-Propaquizafop 2.5% w w^{-1} + Imazethapyr 3.75 % w w^{-1} ME (ready mix) (Dose-83.3g a.i. ha^{-1}); T4- Acifluorfen-sodium 16.5% EC + Clodinafop-propargyl 8% EC (ready mix) (Dose-210 g a.i. ha^{-1}); T5- Fomesafen 11.1% w w^{-1} + Fluazifop-p-butyl 11.1% w w^{-1} (ready mix) (Dose-440 g a.i. ha^{-1}); T6-Hand weedingtwice at 20 and 40 DAS; T7- Weed free (HAND WEEDINGat 20, 40 and 60 DAS); T8- Unweeded check

Among the herbicidal treatments maximum weed control efficiency at 40, 60 DAS and at harvest were recorded under fomesafen 11.1% w w^{-1} + fluazifop-p-butyl 11.1% w w^{-1} (ready mix) (Dose-440 g a.i. ha^{-1}) (T5)(75.2, 64.5 and 66.0 % on mean basis)(Table 4) followed by propaquizafop 2.5% w w^{-1} + imazethapyr 3.75 % w w^{-1} ME (ready mix) (Dose-83.3g a.i. ha^{-1})(T3) and acifluorfen-sodium 16.5% EC + clodinafop-propargyl 8% EC (ready mix) (Dose-210 g a.i. ha^{-1})(T4). Moreover, weed free (T7) recorded significantly the highest weed control efficiency 100 % in year 2021, 2022 and mean also followed by Hand weedingtwice at 20 and 40. The lowest was recorded under unweeded check (T8) regarding weed control efficiency due to high weed density. Among different herbicidal treatments minimum weed index was recorded fomesafen 11.1% w w^{-1} + fluazifop-p-butyl 11.1% w w^{-1} (ready mix) (Dose-440 g a.i. ha^{-1}) (T5) (20.4, 18.0 and 19.2% in year 2021, 2022 and mean, respectively) (Table 2) followed by propaquizafop 2.5% w w^{-1} + imazethapyr 3.75 % w w^{-1} ME (ready mix) (Dose-83.3g a.i. ha^{-1})(T3) and acifluorfen-sodium 16.5% EC + clodinafop-propargyl 8% EC (ready mix) (Dose-210 g a.i. ha^{-1})(T4). The higher WCE and lower WI were calculated under herbicidal treatments due to lower crop-weed competition which reduced weed density as compare to unweeded check (T8).

4. CONCLUSIONS

Above result showed that, among the various weed management practices the herbicidal treatment fomesafen 11.1% ww^{-1} + fluazifop-p-butyl 11.1% ww^{-1} (ready mix) @ 440 a.i.g ha^{-1} at 20 DAS (ready mix) as post emergence (T5) recorded significantly higher yield attributes, seed yield, stover yield, weed control efficiency and minimum weed density and weed index due to efficiently management of weed density. Weed free (T7) however, proved to be best regarding these parameters and the poorest was obtained from unweeded check (T8) for mungbean due to no management practices on weeds.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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