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Fodder Quality and Yields of Mung Bean as Influenced by Different Weed Management Practices

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ABSTRACT

A field experiment was laid out in Randomized Block Design consisted of eight treatments with three replication to find out suitable weed management in summer mung bean (*Vigna radiata*) under zero tillage condition during summer season of 2019-20 under irrigated condition at ICAR-NDRI, Karnal, Haryana. To evaluate the quality of fodder in terms of, organic matter, total ash, crude protein, ether extract, neutral detergent fiber, acid detergent fiber, acid detergent lignin. The result showed that weed free (T_2) plots recorded higher ($P<0.05$) green and dry fodder yield, followed by Shaked (Propaquizafop + Imezathyper) (T_6) and Pendimethalin fb one HW at 20 days after showing (T_4), T_2, T_6 and T_4 recorded higher green fodder yield by 59.32, 40.12 and 39.86% over weedy check (T_1). Among weed control treatments, T_4 recorded significantly higher crude protein, ether extract and dry matter content was at par on T_6 and significantly ($P<0.05$) superior over T_1. Same trends were also observed in CP, EE and dry matter yield (q/ha). The treatments T_4 and T_6 also enhanced fodder quality by reducing neutral detergent fiber, acid detergent fiber and acid detergent lignin content over weedy check. Thus, application of Shaked (Propaquizafop + Imezathyper) at2 l/ha at 20 days post-sowing would increase yield and quality of summer mung bean fodder under zero tillage condition.

Key words: Crude protein, Fodder yield, Fodder quality, Summer mung bean, Weed management

INTRODUCTION

Agriculture plays major role in Indian economy and it contributes about 17.0% of GDP and about 70% of the population is dependent on agriculture and allied activities for their livelihood (Anonymous, 2019). According to 20th livestock census; India has a livestock population of 535.78 millions showing an increase of 4.6% over 19th livestock census. According to it, total number of milch animal (cow and buffalo) is 125.34 million, which is the largest in the world (Tamta *et al.,* 2019; Anonymous, 2020). India has the highest livestock population and ranks number one in milk production (176.35 Million in 2018-19) (Ali, 2007 and Patel *et al.,* 2016). However, the productivity of Indian cattle is lower than global average (Mallikarjun *et al.,* 2019). One of the major reasons behind lower productivity is scarcity of quality green fodder. The problem may be resolved by mixing of legume fodder with cereal fodder crop (Patil *et al.,* 2009 ; Hindoriya *et al.,* 2019).

Mung bean (*Vigna radiata*) is an important short duration legume crop in India. It is quite versatile crop that can be grown for seeds, green manure, and forage crop. Cultivation of mung bean also enhanced physical, biological and chemical properties of soil. Further, soil fertility could be improved through biological nitrogen fixation with symbiotic association with rhizobium from the atmosphere (Peoples *et al.,* 1995). Mung bean forage could supply adequate amount of nutrients to support adult maintenance in sheep (Garg *et al.,* 2004). Mung bean straw can be mixed with rice and wheat straw to make a bulky component in sheep and goat diets. In a comparison of sheep and goat feeding, mung bean straw was found to be palatable to both species with no deleterious effects on animal health (Khatik *et al.,* 2007). DM digestibility of mung bean straw (64%) fed to ewes *ad libitum* was similar to that of the straws of alfalfa, groundnut and cowpea, and was higher as compared to that of pigeon pea straw (54%). Feeding ewes with mung bean straw increased overall DM

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intake from 12.6 to 18.9 g/kg body weight/day (McMeniman *et al.,* 1988).

In the Northern India, productivity and forage quality of forage decline during mid- to late summer. Solutions to seasonal forage shortages during the summer have traditionally included the use of annual warm-season species for pastures, hay, or silage. Non-traditional crops that could be used as fodder during this period include summer-annual legumes such as mung bean. Forage yields of the crop in the northern western region of India have ranged from 2 to 4 t/ha (Ligon, 1945). A potential advantage of mung bean is that it can be sown as late as May or June, and hence may produce a satisfactory forage yield during the time when forage is in short supply in the region. No issue with palatability or anti-nutritional factors have been reported in mung bean.

Weeds are one of the most important factors to reduce yield and quality of fodder mung bean during summer and rainy season. Being a small growing-period crop, it faces serious weed competition right from the early growth stages (Pandey *et al.,* 1999). The critical period of weed competition in mung bean crop was reported during the 25-30 days (Raghvani *et al.,* 1985; Singh *et al.,* 2021). Mung bean yield may be reduced by up to 50-80 % due to weeds depending upon cultivars, soil moisture level, and other environmental conditions (Kumar *et al.,* 2006; Ali *et al.,* 2011). Therefore, there is a need to find out efficient weed management strategy to appreciate higher growth and yield. The progressive transformation of agriculture concerning intensive use of herbicides is gaining momentum in recent years due higher efficacy and lower cost of such herbicides (Butter *et al.,* 2008). Therefore, chemical weeding under such situation turns out to be indispensible and can be the good alternative to hand weeding (HW). Chemical weed confer 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). Keeping the above information in view, the present study was undertaken to assess the effect of different weed management practices fodder yield and quality of summer mung bean cultivated under zero tillage condition.

MATERIALS AND METHODS

The experiment was conducted at Agronomy Research Farm, ICAR-National Dairy Research Institute, Karnal, and Haryana, located at an altitude of 245 m above mean sea level in Trans Indo-Gangetic Plain of India during summer season of 2019-20. The experiment was conducted following randomized block design (RBD) consisting of eight treatments and three replication *viz.*, T_1-Weedy check, T_2 –Weed free, T_3 – Pendimethalin (PE) at 0.75 kg/ha, T_4 -Pendimethalin fb HW at 20 DAS, T_5-Imezathyper (POE) at 75 g/ha at 20 DAS, T_6-Shaked (Propaquizafop+ Imezathyper) (2 l/ha) as POE, T_7 -Pendimethalin at 0.75 kg/ha fb Imezathyper at 75 g/ha at 20 DAS and T8-Pendimethalin at 0.75 kg/ha fb Quizolofop ethyl at 50 g/ha at 20 DAS. 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) content.

Data on yield was recorded at harvest. Five plants for each treatment were taken for recording the various data. To estimate the quality of fodder crop, representative samples were oven-dried at 60°C to constant weight to determine dry matter (DM) content, was ground using a Wiley mill to pass through a 1 mm sieve and were stored into an airtight polythene bags till further analysis. Proximate principles namely crude protein (CP), crude fiber (CF), ether extracts (EE) and ash was determined according to AOAC (1990). Neutral detergent fibre, acid detergent fiber and acid detergent lignin were measured following methods of Van Soest *et al.* (1991). Non- fiber carbohydrate (NFC) was calculated by following formula:

NFC = 100 – (crude protein% - NDF% - ash% - crude fat %)

Data on growth yield and quality parameters were subjected to analysis of variance given by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

The data presented in Fig. 1 showed that the use of weed management significantly (P<0.05) influenced the green and dry fodder yield. Weed free plots recorded the highest green and dry fodder yield (63.30 and 18.25 q/ha) followed by Shaked (Propaquizafop + Imezathyper) at 20 DAS (55.67 and 14.73 q/ha) treated plots. Weed free treatment and Shaked as POE at 20 DAS recorded (59.32 and 40.12%, respectively) higher green fodder over weedy check. Thus, efficient weed control by herbicides combined with HW influenced yield. Raman and Krishnamoorthy (1999) found the similar results. Variation in yield components of mung bean could be due to difference in growth parameters such as dry matter production. The DM production was outcome of growth parameters like plant height, number. of branches/ plant, number of leaves and LAI. Higher growth attributes lead to higher DM production leading to higher yield.

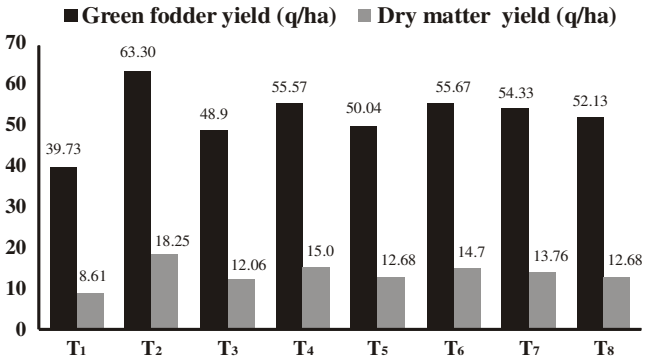

Fig. 1. Effects of different weed management practices on green and dry fodder yield

To provide reasonable diet to the animal, protein is very significant constituents of animal feed because of it play prime role to enhance productivity of animals as protein is used for build- up of new tissue as well as repairing injured tissue. The data on dry matter and crude protein content of mung bean fodder are mentioned in Table 1. The results revealed that weed free plots maximum (P<0.05) dry matter and crude protein (28.83 and 15.16%) followed by Pendimethalin as PE fb one HW at 20 DAS (27 and 14.19%). Other treatment plots also observed significantly higher (P<0.05) dry matter and crude protein content over weedy check. Weedy check recorded significantly lowest dry matter (21.67 and 12.20%). Similar results were also observed by Peer *et al.* (2013). Weed free, Pendimethalin as PE fb one HW at 20 DAS and shaked managed plots recorded lowest weed growth and crop weed competition for air (CO_2), leading to increased photosynthesis activities of plants, which helped generate greater dry matter accumulation (Srinivashu *et al.,* 2004; Ginwal *et al.,* 2019)). Additionally, less crop weed competition for nutrients might have aided higher absorption of nutrient by crop that reflected in higher amino acid and crude protein content.

Data pertaining to organic matter and total ash

Table 1. Effects of different weed management practices on dry matter and crude protein content of fodder mung bean

Treatments	Dry matter (%)	Crude protein (%)
Weed check	21.67	12.20
Weed free	28.83	15.16
Pendimethalin (PE)	24.67	13.23
Pendimethalin (PE) fb one hand weeding	27.00	14.19
Imezathyper (POE) at 20 days after sowing	25.33	13.37
(Propaquizafop + Imezathyper) as POE	26.4	13.95
Pendimethalin (PE) fb Imezathyper (POE)	25.33	13.67
Pendimethalin (PE) fb Quizolofop ethyl	24.33	13.47
SEm (±)	0.55	0.29
CD (P=0.05)	1.66	0.89

SEm, standard error of mean; CD, critical difference

Table 2. Effects of different weed management practices on total ash, organic matter (OM), and ether extract (EE) content of fodder mung bean

	Ash(%)	OM(%)	EE(%)
Weed check	11.27	88.73	2.41
Weed free	12.17	87.83	2.65
Pendimethalin (PE)	11.34	88.66	2.48
Pendimethalin (PE) fb one hand weeding 20 DAS	12.16	87.84	2.62
Imezathyper (POE) at 20 DAS	11.65	88.35	2.53
(Propaquizafop + Imezathyper) as POE at 20 DAS	11.61	88.39	2.61
Pendimethalin (PE) fb Imezathyper (POE) at 20 DAS	12.02	87.33	2.42
Pendimethalin (PE) fb Quizolofop ethyl at 20 DAS	11.89	88.11	2.54
SEm (±)	0.26	0.26	0.06
CD (P=0.05)	NS	NS	0.08

DAS, days after sowing; SEm, standard error of mean; CD, critical difference

content of mung bean fodder are presented in Table 2 which showed non-significant effect of weed management treatments, however, weed free plots recorded significantly (P<0.05) higher ether extract (2.65%) content which was at par on Pendimethalin as PE fb one HW at 20 DAS (2.62%) and Shaked at 20 DAS (2.61%). Increasing EE content boost availability of fat soluble vitamins *i.e*. A, D, E and K. Ether extract recorded higher under those treatments, which have low crop-weed competition due to efficient management of weed during critical competition period. Data presented on table 3 show that CP and EE yield was significantly affected due to different weed management practices. Weed free plots recorded significantly (P<0.05) higher CP and EE yield (2.77 and 0.48 q/ha) which was at par on Pendimethalin as PE fb one HW at 20 DAS and Shaked at 20 DAS. Total ash yield did not vary significantly due to different weed management treatments. Higher total ash yield was recorded in weed free treatment followed by Pendimethalin as PE fb one HW at 20 DAS and Shaked at 20 DAS.

The data pertaining to NDF, ADF and ADL (Table 4) revealed that weedy check plots recorded significantly (P<0.05) higher NDF, ADF and ADL

Table 3. Effects of different weed management practices on crude protein (CP), ether extract (EE) and total ash yield

Treatments	CP yield (q/ha)	EE yield (q/ha)	Total ash yield (q/ha)
Weed check	1.05	0.21	2.44
Weed free	2.77	0.48	3.51
Pendimethalin (PE)	1.60	0.30	2.79
Pendimethalin (PE) fb one hand weeding 20 DAS	2.13	0.39	3.28
Imezathyper (POE) at 20 DAS	1.70	0.32	2.95
(Propaquizafop + Imezathyper) as POE at 20 DAS	2.05	0.37	3.07
Pendimethalin (PE) fb Imezathyper (POE) at 20 DAS	1.88	0.33	3.04
Pendimethalin (PE) fb Quizolofop ethyl at 20 DAS	1.71	0.32	2.85
SEm (±)	0.04	0.01	0.09
CD (P=0.05)	0.78	0.11	NS

DAS, days after sowing; SEm, standard error of mean; CD, critical difference

Table 4. Effects of different weed management practices on neutral detergent fibre (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL), hemicelluloses and cellulose content of fodder mung bean

Treatments	NDF (%)	ADF (%)	ADL (%)	Hemi cellulose (%)	Cellulose (%)
Weed check	41.97	31.06	5.67	10.91	22.43
Weed free	37.00	28.07	4.72	8.93	23.35
Pendimethalin (PE)	40.15	28.53	5.17	11.62	23.37
Pendimethalin (PE) fb one HW 20 DAS	37.16	27.57	4.97	9.59	22.60
Imezathyper (POE) at 20 DAS	41.41	30.21	5.30	11.20	25.64
(Propaquizafop + Imezathyper) as POE at 20 DAS	38.00	28.87	4.93	9.13	26.16
Pendimethalin (PE) fb Imezathyper (POE) at 20 DAS	37.33	29.60	5.18	7.73	24.26
Pendimethalin (PE) fb Quizolofop ethyl at 20 DAS	37.50	27.00	4.83	10.50	22.17
SEm (±)	1.95	1.10	0.19	0.65	0.97
CD (P=0.05)	NS	NS	NS	NS	NS

DAS, days after sowing; SEm, standard error of mean; CD, critical difference

(41.97, 31.09 and 5.67%, respectively) followed by Imezathyper as POE (41.41, 30.21 and 5.30%, respectively). Weed free plots recorded lowest (P<0.05) NDF, ADF and ADL value (37, 28.07 and 4.72%, respectively). Herbicides application did not affect NDF and ADF content in pasture (Cinar *et al.,* 2013). The total NDF (%) content of crop were decided by crop morphology, genetic constituents and agronomic managements. Low NDF, NDF and ADL content indicates good quality fodder. Inverse relationship is there between lignin content and digestibility. Propaquizafop + Imezathyper as POE at 20 DAS recorded higher cellulose content, whereas application of Pendimethalin (PE) recorded higher hemicellulose content as compared to other treatments (Table 4).

NFC is made-up of starch, soluble fiber and simple sugars. Data pertaining to NFC and TDN are presented on Table 5. TDN yield was significantly (P<0.05) affected by treatments and higher value was recorded in weed free (39.20 q/ha) plots followed by plots treated with Shaked as POE at 20 DAS (34.28 q/ha) and Pendimethalin (PE) fb one HW 20 DAS (34.20). Higher NFC and TDN value indicate higher fodder quality. Weed free condition improve plant growth and health, this ultimately leads to higher fodder quality (Yadav *et al.,* 2016).

Table 5. Effects of different weed management practices on non- fiber carbohydrate (NFC), total digestible nutrient (TDN) and total digestible nutrient yield of mung bean

Treatments	NFC (%)	TDN (%)	TDN yield (q/ha)
Weed check	33.71	59.52	23.65
Weed free	34.71	61.93	39.20
Pendimethalin (PE)	34.37	60.82	29.74
Pendimethalin (PE) fb one HW 20 DAS	35.35	61.54	34.20
Imezathyper (POE) at 20 DAS	32.51	60.02	30.03
(Propaquizafop + Imezathyper) as POE at 20 DAS	35.52	61.57	34.28
Pendimethalin (PE) fb Imezathyper (POE) at 20 DAS	36.14	60.66	32.96
Pendimethalin (PE) fb Quizolofop ethyl at 20 DAS	36.13	61.83	32.23
SEm (±)	0.26	1.66	0.26
CD (P=0.05)	NS	NS	4.56

DAS, days after sowing; SEm, standard error of mean; CD, critical difference

Table 6. Correlation matrix of green fodder yield *vs.* fodder quality

Pearson	Correlations										
	GFY	**CP**	**EE**	**TA**	**NDF**	**ADF**	**ADL**	**HC**	**Cellulose**	**OM**	**DM**
GFY	1										
CP	.986**	1									
EE	.772*	.822*	1								
TA	.819*	.809*	0.562	1							
NDF	-.837**	-.786*	-0.56	-.84**	1						
ADF	-0.627	-0.611	-0.641	-0.59	.765*	1					
ADL	-.894**	-.866**	-.801*	-.710*	.856**	.875**	1				
HC	-0.64	-0.578	-0.2	-0.69	.749*	0.15	0.414	1			
Cellulose	0.211	0.151	0.155	-0.13	0.104	0.35	-0.01	-0.2	1		
OM	-0.662	-0.604	-0.174	-.88**	.770*	0.33	0.472	.841**	0.026	1	
DM	.961**	.982**	.834*	.751*	-0.7	-0.54	-.80*	-0.52	0.271	-0.55	1

**.Correlation is significant at the 0.01 level (2-tailed); *Correlation is significant at the 0.05 level (2-tailed); GFY, green fodder yield; CP, crude protein; EE, ether extract; TA, total ash; NDF, neutral detergent fiber; ADF, acid detergent fiber, ADL, acid detergent lignin; HC, hemi cellulose, OM, organic matter, DM, dry matter

Correlation studies (Table 6) indicates that the fodder quality of mung bean i.e., CP (r=0.986), EE (r=0.772), TA (r=0.819) and DM (r=0.961) content were positively correlated with green fodder yield. Cellulose content was also positively correlated with fodder yield, but the association was moderate (r=0.211). Green fodder yield was negatively correlated with the contents of NDF (r= -0.837), ADF (r= -0.627), ADL (r= -0.894) and HC (r= -0.64). Quality parameter like CP, EE, DM and TA increase with increase in green fodder yield, however, fiber fractions like NDF, ADF and ADL are inversely related with green fodder yield. Correlation matrix also indicates that CP and other quality parameters were inversely related with fiber fractions.

CONCLUSION

Based on the present finding it may be concluded that application of Shaked (Propaquizafop + Imezathyper) at 2 l/ha at 20 DAS may be recommended to obtain higher yield and fodder quality of summer mung bean under zero tillage condition.

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