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Performance of Cultivars and Tillage Methods on Growth, Yield and Economics of Lentil Under Rice-Lentil System in Garo Hills, Meghalaya

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ABSTRACT

Frontline demonstrations were carried out at 859 farmers' field of four districts covering an area of 238.68 ha in 89 villages of Garo Hill districts, Meghalaya during rabi season, 2013- 2016 to study the effect of different cultivars and tillage methods on growth, yield and economics of lentil in rice fallow areas. The cultivars of lentil evaluated were HUL 57, WBL 77, Patnai (local) and tillage methods were conventional, relay and zero tillage. Results revealed that the higher significant values were recorded under conventional sowing incorporating bio fertilizer (*Rhizobium*) in terms of seed yield (8.62 q/ha) and net return (Rs. 28,103/ ha). However, as per benefit cost ratio, highest values were found in relay cropping (2.80) in comparison to other sowing methods. Significantly lower seed yield was recorded in zero tillage than conventional and relay cultivation methods. Among the varieties tested, WBL77 produced the highest seed yield of 7.28 q/ ha which showed 45.30 per cent increase over the local variety, a net return of Rs.26643/ha and a benefit cost ratio of 2.76. The lowest production and net returns were found in zero tillage cultivation method.

Key Words: Tillage methods, Lentil, Zero tillage.

INTRODUCTION

Lentil (*Lens culunaris* L.) is the second most important winter legume crop of India, after Bengal gram (Singh *et al*, 2014a). It is one of the prominent sources of vegetable protein in the Indo-Gangetic plain region, essentially grown as rainfed crop on the residual soil moisture of preceding crop (rice in general) (Ali *et al,* 2012). It contains high amount of digestible protein (35%), macro- and micronutrients, particularly iron and zinc and vitamins, thus provides nutritional security to its consumers. It is primary constituent of native cropping sequences, and can be used as an excellent soil fertility restorer (Singh *et al,* 2015). Rice is energy exhaustive crop of India with and more than 10 mha of land in India is left fallow after rice harvest (Singh *et al* , 2019) among which 82per cent areas of rice-fallow lies in the states like Assam, Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Orissa, West Bengal and North Eastern states (Pande *et al,* 2010) and there exists a scope for expansion of area under pulse crops like lentil in rice fallows (Das *et al,* 2013).

In North Eastern region of India, where a large part of the area remains fallow after the *kharif* rice (Das *et al,* 2012), lentil has a very good potential for increasing farm income as well as cropping intensity (Das *et al,* 2013). Thus, introduction of lentil in rice fallows with appropriate production technologies may usher in another green revolution in the backward, poverty ridden and deprived region of the country. Furthermore, frequent occurrence of drought in these areas creates water scarcity problem at the time of sowing of different crops. There is need of development of effective cropping system for rainfed area, so that farmers may get maximum output. Minimum tillage with crop residue management is found to reduce soil water evaporation, soil sealing and crusting. Early

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maturing lentil varieties may escape the terminal moisture stress in rice fallow (Erskine *et al,* 2011) and could convert these mono-cropped areas into double cropped and thus, increase legume production and sustain productivity of the rice-based systems. To improve land productivity, food and nutritional security in this region, rice- fallow areas must be brought under cultivation with pulse crops that can survive in residual moisture. In view of the above facts, field technology demonstrations were conducted to evaluate the productivity and economic performance of lentil in rice-fallow for nutritional security as influenced by cultivars and tillage methods.

MATERIALS AND METHODS

Field technology demonstrations under rainfed condition were planned and executed for three consecutive years on 238.68 ha area in West, South West, North and East Garo Hills districts of Meghalaya during rabi season, 2013-14 to 2015-16. In these demonstration, three lentil varieties *viz.* HUL 57, WBL 77 and local cultivar *patnai* along with three cultivation methods *i.e.* conventional, relay and zero tillage were evaluated in rice- lentil system in randomized block design (RBD) replicated in 4 districts. The harvesting of *kharif* paddy was done manually in the month of November. After the harvest, lentil crop was sown in conventional, relay and zero tillage during 1st to 2nd fortnight of November. The recommended dose of *rhizobium* inoculation @ 20g /kg of seed was done prior to sowing of seeds. Seeds were sown at 2-3 cm depth at 30 cm row distance. Farm yard manure @ 5t/ha, 20 kg N, 40 kg P_2O_5, 20 kg K_2O, 20 kg S/ha and 10 – 15 kg/ha ZnSO4 were applied as basal dose as well as other agronomic management practices were followed as per recommendations and were kept similar for all the treatments.

Foliar application of 2% urea/DAP (i.e. 200 g/10 l water) at flowering and pod formation was also done. One hand weeding after three weeks of sowing was performed to maintain optimum plant population. The crop was raised with residual soil moisture and one life saving irrigation was provided at flowering stage for better growth. Crops were harvested depending on the maturity of different varieties. Yield attributes (pods/plant, seeds/pod and 1000 test weight) and seed yield of lentil were recorded at harvest. Yield of lentil was estimated from weight of sun dried seeds obtained from each net plot after threshing and cleaning at 12per cent moisture content. Variable cost of cultivation, gross return, net return and benefit cost ratio were calculated considering the wages of local labour, input prices and selling of seeds at prevailing market prices. Data generated during the course of experimentation were statistically analysed (Cochran and Cox, 1967) using the Analysis of Variance (ANOVA) technique as detailed by Gomez KA and Gomez (1984).

RESULTS AND DISCUSSION

Yield attributes

Among the varieties evaluated, WBL 77 recorded the highest number of pods/plant (85.97) and number of seeds/pod (1.41) followed by HUL 57 and Patnai cultivars. The 1000 seed weight was observed to be maximum in WBL 77 (23.90g) as compared with HUL 57 (22.53 g) and Patnai (17.30), respectively. Results revealed that the maximum number of pods/plant (92.74), number of seeds/pod (1.35) and 1000 seed weight (22.05g) was observed in conventional method of cultivation while the lowest was recorded in zero tillage method.

Seed Yield

The seed yield of each variety under all the three sowing methods has been recorded, according to which the significant maximum seed yield was observed in WBL 77 (7.28 q/ha) followed by HUL 57 (6.67q/ha) and Patnai (5.01q/ha). The greater number of pods per plant, seeds per pod and 1000 seed weight in lentil resulted in higher seed yield in these cultivars. Similar type of results were also recorded by Maurya and Rathi (2000), Layek *et al* (2013). Data revealed that the conventional sowing method had significant advantage in terms of yield

Table 1. Yield attributes and yields of lentil cultivars as influenced by sowing methods under rice-lentil cropping system(pooled data of three years, 2013-16).

Treatment	No. of pods/ plant	No. of seeds/pod	1000 Seed weight (g)	Seed yield (q/ha)
Cultivars				
HUL 57	82.19	1.37	22.53	6.67
WBL 77	85.97	1.41	23.90	7.28
Patnai (local cultivar)	74.03	1.19	17.30	5.01
SEM (±)	1.11	0.05	0.53	0.14
CD (p=0.05)	3.31	0.17	1.58	0.45
Sowing Methods				
Normal	92.74	1.35	22.05	8.62
Relay	79.85	1.35	21.80	6.02
Zero tillage	69.61	1.28	19.91	4.32
SEM (±)	1.11	0.05	0.53	0.14
CD (p=0.05)	3.31	0.17	1.58	0.45

over relay and zero tillage methods for all the three varieties under testing.

Interaction effect of sowing method and varieties on yield components

The results of interaction effect between variety and sowing method revealed that conventional sowing method produced better results compared to relay sowing and zero tillage method in all the yield parameters (Table 2). Among the varieties, WBL 77 was found to be superior with highest seed yield (10.22q//ha) when sown under conventional sowing method followed by HUL 57 (9.51q/ha) and patnai (4.42q/ha) as shown in Fig.1. The maximum numbers of pods/plant, no. of seeds per pod and

Table 2. Combined effects of varieties and sowing methods on yield components and seed yield of lentil (pooled data of three years, 2013-16).

Interaction (varieties x sowing methods)	No. of Pods/Plant	No. of Seeds/ Pod	1000 Seed Weight (g)	Seed Yield (q/ha)
V_1 x N	94.41	1.32	23.39	9.51
V_1 x R	79.57	1.47	23.37	6.09
V_1 x Z	72.61	1.34	20.83	4.42
V_2 x N	98.02	1.47	24.85	10.22
V_2 x R	86.84	1.40	24.81	6.85
V_2 x Z	73.07	1.37	22.14	4.79
V_3 x N	85.80	1.27	17.91	6.14
V_3 x R	73.15	1.19	17.23	5.13
V_3 x Z	63.15	1.13	16.77	3.77
SEM (±)	1.9333	0.1007	0.9250	0.2592
CD (p=0.05)	5.7441	0.2991	2.7483	0.7702

V_1 = HUL-57; V_2 = WBL-77; V_3 = Patnai; N = Normal sowing; R = Relay sowing; Z= Zero tillage

1000-seed weight (g) were contributing factor for highest seed yield in this treatment combination. The lowest seed yield (3.77q/ha) was recorded in local cultivar patnai under zero tillage sowing method.

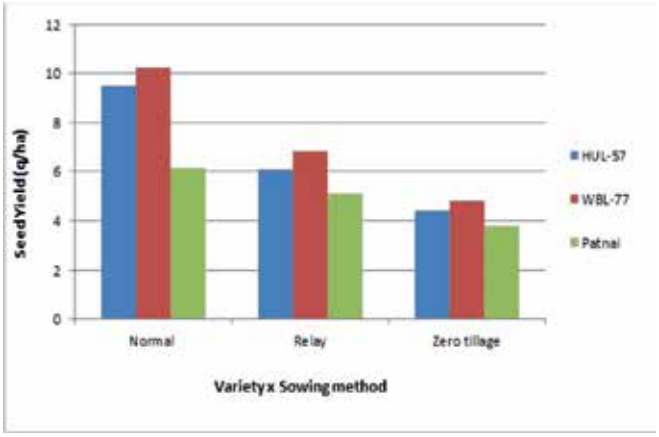

Fig 1. Interaction effect of variety and sowing method on seed yield of lentil

Comparison of Economics

Economic evaluation of any developed technology is the key to know whether developed technology is economically sustainable and feasible or not (Singh *et al*, 2013b). Among the varieties tested the highest net return of Rs. 43680/ha with B:C ratio of 2.56 was recorded in WBL 77 (Table 3). The net returns per unit area were higher for conventional sowing method as compared to relay and zero tillage sowing methods. The benefit-cost ratio was maximum in relay sowing method (2.80) followed by normal (2.18) and zero tillage sowing method (1.66). This might be due to less requirement of extra cost for land preparation and weeding operation in relay method of sowing.

CONCLUSION

It could be concluded that the lentil variety WBL 77 was found to be suitable in terms of seed yield and economics for rice-lentil system under conventional sowing method as compared to relay and zero till technology. Hence, there is enough scope for cultivation of lentil in lowland rice fallow in Garo Hills, Meghalaya. Improved varieties from different research institutes which are uniform in podding should be tested at more locations of the district of Garo Hills to further improve yield and for higher returns.

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Table 3. Economic performances of lentil cultivars as influenced by sowing methods in rice fallow (pooled data of three years, 2013-16)

Treatment	Gross cost (Rs.)	Gross Return (Seed) (Rs.)	Net Return (Rs.)	B:C ratio
Cultivars				
HUL-57	18420	40020	21600	2.17
WBL-77	17037	43680	26643	2.56
Patnai (local cultivar)	14273	30060	15787	2.10
Sowing Methods				
Normal	23617	51720	28103	2.18
Relay	12865	36120	23255	2.80
Zero tillage	15526	25920	10394	1.66

Note: Sale price: Lentil @Rs 600/q

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