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Research Article

Performance of Different Winter Legumes as Relay Crop for Vegetable and Fodder Production within the Fallow Windows of Two Rice for Improving Income of Resource-Poor Farmers of Bangladesh

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Abstract

The field experiment was conducted at the Pulses Research Centre of Bangladesh Agricultural Research Institute, Ishurdi, Pabna, Bangladesh during two consecutive years of 2010-2011 and 2011-2012 cropping season to determine the economic viability of planting legumes for both vegetable and fodder purposes in the fallow period between monsoon and spring rice. The objectives were to find out the suitable pulses as relay crop for vegetable & fodder production, ensure better land utilization, break up the mono cropping, improve soil health, and generate extra-income for small and resource-poor farmes of Bangladesh. Pulses as a member of legumes (grasspea, chickpea and field pea) were used in the experiment. Based on data from two years in a pooled analyses, the highest green vegetable (3.25 t/ha) + fodder (18.1 t/ha) were obtained by field pea and the lowest green vegetable (1.5 t/ha) + fodder (6.5 t/ha) were produced by chickpea. The highest gross return of Tk. 119300/ha, net return of Tk. 85050/ha and BCR 3.48 were found in field pea and the lowest gross return of Tk.43000 / ha, net return of Tk. 22,800/ha and BCR 2.13 werein chickpea. This has also generated job opportunities for rural women to pick the green vegetable of field pea.

Introduction

Bangladesh is a densely populated country, where population density and per capita cultivable lands are, 1265/sq.km and 0.05 ha, respectively[1]. Every year cultivable lands are utilized for housing, office building, roads and others construction work for blooming populations. Day by day, the population per unit area increases but cultivable land decreases which is alarming for growing economy of the country. In this endeavor, researchers, extentionist and farmers are trying to increase cropping intensity through the highest utilization of lands to fulfill the requirements of blooming population. Whereas, after harvesting of monsoon rice some lands are used for short duration mustard cultivation before transplantation of spring rice. Simultaneously grasspea*(Lathyrussativus L.)* and blackgram*(Vigna mungo)* can be grown as relay crop in the existing monsoon rice field as fodder crop before spring rice transplantation. However, about 20% of total cultivable lands (0.829 million ha) remains fallow which can be utilized to cultivate winter pulses like grasspea, chickpea *(Cicer arietinum)* and field pea *(Pisumsativum)* for vegetable and green forage [2]. Apical part of the soft shoot (7.0-7.5cm) is used as vegetable that is choused by the consumers due to it is good taste and high market price. Growing pulses as legumes acts as a catch crop between two rises and provides an extra income and employment to the farmers. In case of chickpea, similar findings also reported [3]. In winter season there is a high scarcity of fodder. Whereas, after picking of growing under shoots, rest of the part of grasspea, chickpea and field pea can be used as nutritious fodder for feeding the animals.

Beside this, to meet high demand of food against her blooming population, the highest emphasis has been given to cereal production, as the population suffers from protein malnutrition. The soil condition is also poor in nutrients and water content. However, growing of legumes helps in improving the soil condition and pulses as a food legume has a role in human food, animal feed and sustainable agriculture [4]. Pulses also act as ameliorative crops and thus, improve the soil health. Soil aggregation, soil structure, permeability, fertility and infiltration rate improved with the inclusion of pulses in the system [5]. A legume cans fix 20-60kg residual N/ha for the succeeding crop[6]. To better performance, higher productivity and income from a cropping system, the constituent crops are to be considered with respect to duration, productivity, economic and physical feasibility, and effects on soil and subsequent crops, which remains to be properly understood, therefore, the present investigation was undertaken.

Materials and Methods

A field experiment was conducted for two consecutive years of 2010-2011 and 2011-2012 on Calcareous Gray Food Plain soils at the Pulses Research Centre of Bangladesh Agricultural Research Institute (BARI), Ishurdi, Pabna, Bangladesh. The experimental soil was clay loam in texture having pH 7.5, containing organic matter 1.2%, total N (%) 0.063, K 12μg/mL, S 15μg/mL& Zn 1.9μg/mL. The experiment was laid out in RCB design with five replications. The unit plot size was 5m × 4m. Winter pulses, i.e.,grasspea (var. BARI Khesari-1), chickpea (var. BARI Chhola-5) and field pea (var. Norail local) were sown in

the existing rice field of monsoon rice (Binadhan-4) as relay crop just after drain out of water from the rice field before 10-15 days of rice harvest on 4 November in 2010 and 26 October in 2011. The crop was fertilized with 40 and 20 kg/ha $P_2O_5$and K_2O, respectively before 2 days of seed sowing. Later on, 40 kg N/ha was top dressed in 2 equal splits at 20 and 40 days after emergence (DAE) during afternoon due to less moisture of soil. Manually weeding was done at 30 days after emergence. Shoot picking for vegetable was started on 52 DAE in grasspea, 56 DAE in chickpea and 52 DAE in field pea in 2010-2011. Similarly, in 2011-2012, it was started on 54 DAE in grasspea, 59 DAE in chickpea and 54 DAE in field pea. Last harvest of vegetable was on 102 DAE in grasspea, 100 DAE in chickpea and 102 DAE in field pea in 2010-2011. Similarly, in 2011-2012, it was on 100 DAE in grasspea, 95 DAE in chickpea and 100 DAE in field pea. After the last pickup for vegetable, pulses were harvested for fodder and weighed before spring rice plantation. All types of variable production costs were recorded to find out the net return and benefit cost ratio (BCR).The recorded data were statistically analyzed. Soil samples were collected during start and compilation of the two years cycle experiment and chemicallyanalyzed. Economic analysis was computed accordingly to Ali[7].

Results and Discussion

The two years pooled results with figures of vegetable and fodder yield of three pulses are presented in Table 1. Significantly, the highest duration of first harvest of vegetable 57 days after emergence (DAE) was observed in chickpea. The lowest duration of first harvest of vegetable 53 DAE was found in grasspea and filed pea. Differences on last harvest of vegetable had no significant effect among the different pulses but numerically the longest duration of last harvest of vegetable 101 DAE was observed in grsspea and field pea. The lowest duration of last harvest of vegetable 98 DAE was observed in chickpea. Total duration of vegetable harvesting was not significant difference but numerically the longest duration of vegetable harvesting 48 days was observed in grasspea and field pea. The lowest duration of vegetable harvesting 40 days was found in chickpea**.** Significant difference was observed in the frequency of vegetable harvesting and it was the highest 7.5 was in field pea which was identical to grasspea and the lowest 5.5 was in chickpea. Significantly the highest vegetable 3.25 t/ha was obtainedfrom field pea which might be due to cumulative influence of early start of vegetable harvest, longest duration of vegetable harvesting and significant increase of vegetable harvesting frequency. The lowest vegetable production 1.5 t/ha was obtained by chickpea due to its later start vegetable harvesting and shortest harvesting duration & the lowest frequency of vegetable harvesting. The highest fodder yield of 18.10 t/ha was produced by field pea and the lowest 6.5 t/ha was in chickpea, it might be due to less crop growth. The highest fodder weight in field pea might be due to its characteristically vigorous plants and resulting in higher number of branches. It was also reported that clipping of the young shoots during vegetative growth caused increase in auxiliary branches which resulted in higher by-product yields in chickpea [8,9].

Before the development of this technology, maximum lands remain fallow within the window of aman and boro rice but at present, these windows are using by the relay cropping of field pea/grasspea as vegetable + fodder. As a result, fallow lands are using through cropping, i.e., same lands are using more times which ensure more benefit, especially resource poor farmers of Bangladesh,because, vegetable harvesting is a laborious job which is only possible by the poorer section(Table 2).

Economics Analysis

Economic performance of different treatments under this study is presented in Table 3. Among the different relay pulses as vegetable + forage, field pea produced the highest gross return of Tk. 119300/ha, net return of Tk. 85050/ha, and BCR 3.48.The lowest gross return of Tk.43000 /ha, net return of Tk. 22,800/ha and BCR 2.13 were found in chickpea . It was noted that, 1$= TK.78.00.Perceptible changes in soil chemical properties occurred through the inclusion of pulses in the rice based cropping pattern is presented in Table 3. After completion of two years cycle, the pH of the soil was decreasing trend but the organic matter, N, P, S and Zn content of the soil was increasing and K remained unchanged irrespective of different pulses. It might be due to inclusion of pulses in the cropping systems. Similar findings also reported byAli[10].

Table 3: Soil fertility status of Initial and after two years cropping cycle (final).

Soil Status	Treatment	pH	OM (%)	Total N (%)	P (µg/mL)	K (µg/mL)	S (µg/mL)	Zn (µg/mL)
Initial	All	7.5	1.2	0.063	12	0.17	15	1.9
Final	Lathyrus	7.4	1.23	0.067	14	0.17	16	2
	Chickpea	7.4	1.23	0.068	15	0.17	17	2
	Filedpea	7.4	1.23	0.067	14	0.17	16	2

Conclusion

The results revealed that, field pea (as vegetable + fodder) performed better which produced the highest production as well as net return. Thus, the cropping system consisting relay crop of field pea (asvegetable & fodder) within the window of aman and boro rice appears to be the most appropriate in terms of vegetable and fodder production, and net returns for resource poor-farmers in Bangladesh. This technology has also generated job opportunities for rural women to pick the green vegetable of pea. The poor farmers of Bangladesh are using this technology; as a result, fallow lands are bringing under cultivation without hamper of existing crops and farmers are getting more benefit from less land.

Table 1: Performance of different relay pulses as vegetable and fodder (pooled over two years). Means with different letters within the same block are significantly different.

Treatment	1st Harvest of Vegetable (DAE)	Last Harvest of Vegetable (days)	Vegetable Harvesting duration (days)	Frequency of Vegetable Harvesting	Total Vegetable wt. (t/ha)	Total Fodder wt. (t/ha)
Grasspea	53.0b	101	48	6.5ab	2.45b	16.75b
Chickpea	57.5a	98	40	5.5b	1.50c	6.50c
Field pea	53.0b	101	48	7.5a	3.25a	18.10a
CV (%)	4.08	3.95	6.7	7.48	12.65	13.4
LSD (0.05)	2.3	5.9	8	1.2	0.3	1.1

Table 2: Agro-economic performance of different relay pulses as vegetable and fodder (pooled over two years).

Treatment	Vegetable wt. (t/ha)	Fodder wt. (t/ha)	Total variable cost (Tk/ha)	Gross return (Tk/ha)	Net return (Tk/ha)	BCR
Lathyrus	2.45	16.7	28800	98100	69300	3.41
Chickpea	1.5	6.5	20200	43000	22800	2.13
Field pea	3.25	18.1	34250	119300	85050	3.48
Price						
Pulses	Seeds	Vegetable	Fodder	Vegetable picking	Labour	
Grasspea	Tk. 60.00/kg	Tk. 20.00/kg	Tk. 3.00/kg	Tk. 8.00/kg	Tk. 200/head/day	
Chickpea	Tk. 80.00/kg	Tk. 20.00/kg	Tk.2 .00/kg	Tk. 7.00/kg		
Field pea	Tk. 60.00/kg	Tk. 20.00/kg	Tk. 3.00/kg	Tk. 8.00/kg		

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