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Studies on growth, yield and competition functions of rice and green gram under pure and mixed stands

Rajesh Kumar Saha, B. K. Saren* and T. Chakraborty

Institute of Agriculture, Visva-Bharati, Sriniketan – 731236, West Bengal, India

ABSTRACT

The beneficial effect of intercropping of cereal (rice) and legumes (Green gram) with suitable row ratios studied under lateritic acidic soil condition of Visva-Bharati, West Bengal. Sole rice and green gram (Panna and PDM-84-139) recorded the maximum plant height, yield attributes and crop yields. Among the intercrops, rice crop sown with green gram at 2:1 row showed better performance than in other row ratios. The highest rice equivalent yield was observed at 2:1 ratio of rice+green gram cv. Panna but 1:1 ratio showed the highest benefit cost ratio. A minimum of 43.9% higher rice equivalent was observed under rice+PDM-84-139 green gram at 2:2 row ratio than rice alone. Competitive functions like relative crowding co-efficient, Land equivalent rati monetary advantage, area time equivalent ratio and relative value total were found maximum at 2:1 ratio of rice + green gram and green gram was found dominant crop in the intercropping systems.

Key words: *rice, legume, intercropping, economics, competition function*

Rainfed upland rice occupies a significant position in Indian Agriculture. Continuous growing of rice on upland has adverse effect on soil physico-chemical properties and stability in yield. Thus for proper soil and crop management and to get a stable higher economic return in stress situation, inclusion of legumes and oilseed crops with rice as intercrop found beneficial. Cereals+grain legumes or oilseed crops intercropping are also important to meet the deficit of production of pulses and oilseeds in India. Hence, the present experiment was undertaken to study the economic profits of intercropping of rice and green gram.

MATERIALS AND METHODS

The experiment on intercropping of direct seeded rice (var. IR-36) and green gram (var. Panna and PDM-84-139) was conducted during the wet seasons of 2003 and 2004 under lateritic acidic soil of Agricultural Farm, Visva-Bharati, Sriniketan, West Bengal, India having loamy texture, pH 6.15, organic carbon – 0.34%, total nitrogen – 0.036%, available P2O5 – 18.6 kg/ha and available K2O – 151.93 kg/ha. There were nine treatments viz. T1- sole rice, T2 – sole green gram (Panna), T3- sole green gram (PDM-84-139), T4- rice + green gram (Panna) at 1:1 ratio, T5 – rice + green gram (PDM-84-139) at 1:1 ratio, T6 – rice + green gram (Panna) at 2:1 ratio, T9 - rice + green gram (PDM-84-139) at 2:1 ratio, T8- rice + green gram (Panna) at 2:2 ratio, T9- rice + green gram (PDM-84-139) at 2:2 ratio. The treatments were allotted in randomized block design with 4 replications. The fertilizer applied @ 60:40:40 and 20:40:40 N, P and K for rice and green gram, respectively under sole seeding but under intercropping system fertilizers are incorporated depending on the row ratios of the respective crops.

The rice crop was sown in continuous lines but green gram was sown at 10cm apart within the rows keeping the row spacing of 25cm on June 23, 2003 and June 18, 2004. Seed rate used for rice was 60 kg/ha whereas for green gram it was 20 kg ha^{-1} under pure stands.

RESULTS AND DISCUSSION

Intercropping significantly influenced the height and dry matter accumulation of plant. Due to minimum interspecies competition, maximum plant height and dry matter accumulation were found in sole crops planting (Sarawgi and Tripathi,1999). Green gram variety PDM-84-139 recorded the higher plant height and dry matter

production than in Panna. The lowest plant height of rice was observed in intercropping of rice + green gram variety PDM-84-139 sown in 1:1 ratio but green gram PDM-84-139 variety intercropped with rice at 2:2 ratio showed the minimum height (Table 1). The results are in accordance with findings of Rajput and Mishra (1990).

Yield attributes viz. effective tiller, grains number and test weight of sole rice were significantly higher than in that of both the ratios of green gram varieties and rice intercropped with green gram variety PDM-84-139 at 1:1 ratio showed the lowest result. Intercropping effect on rice test weight was not significant except rice + green gram variety PDM-84-139 at 2:2 ratio probably due to better performance of PDM-84-139 that suppressed the growth and development of rice.

Between the green gram varieties, pure stand of PDM-84-139 showed better result than Panna in yield attributes. The results are in conformity with the findings of Mandal *et al.* (2000). Green gram variety PDM-84-139 produced more effective branches and pods with bold seed than Panna variety. However, green gram intercropped with rice produced significantly lower test weight than the sole sown green gram might be due to higher crop competition in mixed cropping. Mandal *et al.* (1989) also reported the less seed weight in intercropping than those in sole cropping.

Similarly, sole rice and green gram recorded the highest yield but crops sown as mixed stands produced the lowest yield, which might be due to intercrop competition. Rice crop sown with green gram cv. Panna at 2:1 row ratio recorded the highest rice equivalent. A minimum of 43.9% higher rice equivalent was observed under rice + green gram cv. PDM-84-139 at 2:2 row ratios than pure rice. But rice + green gram sown at 1:1 row ratio showed the highest benefit cost ratio probably due to lower cost of cultivation in 1:1 row ratio than 2:1 row ratio (Table 2).

Among the intercropping systems of rice+green gram variety Panna at 2:1 ratio recorded the highest relative crowding coefficient, land equivalent ratio, monetary advantage, area time equivalent as well as relative value total. Results indicated that 2:1 row ratio of rice+green gram cv. Panna was more advantageous as intercropping than others (Table 3). Panna variety

Table 1. Effect of intercropping on growth and yield attributes of rice and green gram

Treatments	Plant height (cm)		Dry matter accumulation (gm^{-2})		No. of effective tillersm^{-2}	No. of effective branches plant^{-1}	No. of grains panicle^{-1}	No. of pods plant^{-1}	Rice1000 grain weight (g)	Green gram1000 grain weight (g)
Sole rice (R)	92.2	-	517.7	-	424	-	77	-	20.64	-
Sole green gram (GG) (Panna)	-	80.1	-	1402.5	-	9.8	-	50	-	35.75
Sole green gram (GG) (PDM-84-139)	-	81.2	-	1432.2	-	10.2	-	52	-	38.0
R + GG (Panna) 1:1	81.9	75.3	414.2	1267.2	288	8.9	74	46	20.13	35.03
R+GG(PDM-84-139) 1:1	80.8	63.2	381.9	1329.9	280	9.3	72	47	19.38	37.8
R+GG (Panna) 2 :1	84.7	68.5	432.9	1148.4	304	8.5	75	45	19.90	34.89
R+GG(PDM-84-139) 2 :1	85.9	64.9	409.6	1280.4	288	9.1	73	47	19.80	37.8
R + GG (Panna) 2:2	85.3	73.7	375.8	1217.7	288	8.7	73	43	19.88	34.80
R+GG(PDM-84-139) 2:2	83.1	63.4	354.3	1234.2	280	8.8	69	42	19.60	38.0
CD (P=0.05)	9.85	12.59	84.9	156.45	34.12	1.37	2.82	0.97	1.24	2.61

Table 2. Effect of intercropping on yield and economics of rice and green gram

Treatments	Grain yield of rice (t ha^{-1})	Seed yield of green gram (t ha^{-1})	Rice equivalent (Rs. ha-1)	Net return (Rs. ha^{-1})	Benefit : cost ratio
Sole rice (R)	2.15	-	21.52	4146	1.30
Sole green gram (GG) (Panna)	-	0.567	22.68	4460	1.64
Sole green gram (GG) (PDM-84-139)	-	0.600	24.00	5120	1.74
R + GG (Panna) 1:1	1.67	0.443	33.39	10021	1.98
R+GG(PDM-84-139) 1:1	1.55	0.437	33.00	9238	1.90
R+GG (Panna) 2 :1	1.80	0.419	34.73	9719	1.86
R+GG(PDM-84-139) 2 :1	1.66	0.436	34.04	8798	1.77
R + GG (Panna) 2:2	1.50	0.422	31.90	8608	1.84
R+GG(PDM-84-139) 2:2	1.37	0.430	30.97	7709	1.75
CD (P=0.05)	0.17	0.075	-	-	-

Table 3. Effect of intercropping competition functions of rice and green gram

Treatments	Competitive functions								
	*RCC			Aggressivity		*LER	*MA	*ATER	*RVT
	*KRG	*KGR	*K	*ARG	*AGR				
R + GG (Panna) 1:1	3.43	3.23	11.07	-0.01	0.01	1.53	6871.74	1.42	1.14
R+GG(PDM-84-139) 1:1	2.58	2.68	6.91	-0.01	0.01	1.44	5828.40	1.33	1.10
R+GG (Panna) 2 :1	10.12	1.41	14.26	-0.96	0.96	1.56	7354.55	1.45	1.19
R+GG(PDM-84-139) 2 :1	6.74	1.32	8.89	-1.03	1.03	1.49	6429.44	1.38	1.13
R + GG (Panna) 2:2	2.31	5.48	12.49	-0.14	0.14	1.43	5639.40	1.32	1.06
R+GG(PDM-84-139) 2:2	1.74	2.52	4.38	-0.16	0.16	1.14	2147.88	1.23	1.01

* RCC- Relative crowding co-efficient; KRG- Co-efficient of rice in presence of green gram; KGR- Co-efficient of green gram in presence of rice; K-Co-efficient of the intercropping (KRG x KGR); ARG- Aggressivity of rice over that of green gram; AGR- Aggressivity of green gram over that of rice; LER- Land equivalent ratio; MA- Monetary advantage; ATER- Area time equivalent ratio; RVT- Relative value total.

performed much better than PDM-84-139 variety for intercropping with direct seeded wet season rice. Similar results were also reported by Mondal et al. (1990). As green gram crop varieties are quick growing they were found dominant whereas rice crop was observed dominated in the intercropping system. The lowest intercropping advantage was observed under rice+green gram variety PDM-84-139 at 2:2 row ratio.

Hence, it can be concluded that intercropping of direct seeded rice with green gram always performed better and 2:1 ratio of rice+green gram was more promising.

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