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Maize+Legume intercropping response to different levels of nitrogen

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Abstract
A field experiment was carried out during Kharif 2014 on research farm of CPGS (CAU-Imphal), Umiam (Meghalaya) to study the effect of varying N levels in maize-legume intercropping as per recommended dose of nitrogen (RDN) for the respective crops. Maize intercropped with soybean recorded significantly more stover and biological yield over groundnut intercropped maize however, maize grain yield was at par in both the intercropping systems. Maize+soybean also recorded relatively higher uptake of N by maize grain, stover and their total however, the difference between both the intercrops was at par for these entire N uptake in maize. All N treated plots recorded significantly higher values of yield attributes and N uptake over control where the maximum value was associated with 75% RDN of maize to maize + 25% RDN of maize to IC. Grain, stover and biological yield was significantly higher in intercrop groundnut over intercrop soybean. The yield of legume intercrops increased only up to 50% RDN of IC to IC. Maize+groundnut intercrop gave significantly higher maize equivalent yield, net return and B: C ratio and also left significantly more residual N in soil over maize+soybean intercrop. Statistically at par, MEY at $maize_{60}$ + IC_{10} with $maize_{80}$ + IC_{20} opened the possibility of saving of 30 kg N ha^{-1} in maize+legume intercrop.

Keywords: Variable N doses, Maize+legume intercropping, maize equivalent yield, nutrient uptake, residual soil N

Introduction
Maize (Zea *mays* L.) is a valuable food grain grown all over the world with wide adaptability. It is the third most important food grain in India after wheat and rice that occupied 8.55 M ha with an annual production and productivity of 21.73 M t and 2.54 t ha^{-1},respectively (Anonymous, 2012) [1]. Its importance lies in its wide industrial application besides serving as human food and animal feed. However, it is the second most important food crop of North Eastern Region (NER) where it is grown in 2.25 lakh ha area with the production and productivity of 3.60 lakh tonnes and 1.6 t ha^{-1}, respectively but its productivity is low due to poor supply of plant nutrients especially nitrogen (N). N is a vital plant nutrient and a major yield determining factor required for maize production and when N is sub optimal, plant growth is reduced (Hague *et al*., 2001) [12]. Legumes are very important both ecologically and agriculturally because they are responsible for a substantial part of the global flux of N from atmospheric N to fixed form (Patriarca *et al*., 2002) [24]. An association between a non-legume and legume species is beneficial as it improved the N nutrition of non-legume plant due to their N-fixing ability (Hamel *et al*., 1991) [13]. Thus, N fixing legume is an important source for intercropped cereals which benefited the N uptake and improved grain yield (Shen and Chu 2004; Betencourt *et al*., 2012) [27, 5].
Among all the oilseed crops, groundnut (*Arachis hypogaea)* accounts for more than 40% acreage and 60% production in the country. A hallmark trait of legumes like groundnut is their ability to develop root nodules and to fix atmospheric N in symbiosis with compatible Rhizobia (Graham and Vance, 2003) [11]. It is a potential crop for the agro climatic condition of Northeast India, since it increases soil fertility, conserves soil and nutrient due to its spreading nature and increases productivity of succeeding crop (Munda *et al*., 2006) [22]. Soybean (*Glycine max*) is another major oilseed crop in the world accounting for nearly 50% of the global oilseeds production. Maize can be used for intercropping with soybean (Khokhar *et al*., 2004; Singh *et al*., 2008) [18, 28] due to their dissimilar growing patterns, morphology, phenology, and nutrient requirement (Willey *et al.* 1983) and the ability to fix atmospheric N (Vance 1998), which offers minimum competition for N nutrition (Ofori and Stern 1987; Rerkasem *et al*. 1988) [23, 25] and greater opportunities to sustain productivity (Jeyabal and Kuppuswamy 2001) [16]. However, meagre information was available on optimization of N in

cereal-intercropping system considering the biological fixing of N by the legumes. Hence, it is important to estimate the N demand of intercropped maize grown with groundnut and soybean, so that all crops can achieve their optimum yield potentials.

Materials and Methods

Experimental Site

The investigation was carried out at the experimental farm of the College of Post Graduate Studies (CAU), Umiam in Ri - Bhoi district of Meghalaya during the *kharif* 2014 located in North-Eastern Hill Region (NEH) of India at 25°41'N latitude, 91°54'E longitude and at an elevation of 950 m above the mean sea level. The experimental site received an average annual rainfall of 2,617.10 mm. The weekly average of the maximum and minimum temperature during the cropping season ranged from 30.2- 25.30C and 20.6-12.10C, respectively. The mean relative humidity ranged from 93.4-2082.0% in the morning and 83.4-62.9% in the evening hours. The soil of the experimental site was moderately acidic in reaction (pH-5), high in organic carbon (1.89%), medium in available phosphorus (18.3 kg ha^{-1}) and potassium (156 kg ha^{-1}) and low in available nitrogen (211 kg ha^{-1}).

Description of Treatments

Maize was intercropped with two legumes namely soybean and groundnut and the varieties used in the study were HM4, ICGS -76 and JS-335, respectively. The experiment was laid out in randomized block design (RBD) with six different levels of N and three replications giving rise to 12 treatment combinations (Table 1). The ultimate plot size was (3.6 x 2.4) m^2. A distance of 45 cm between two maize rows and 90 cm between two pairs of the maize rows was maintained while two rows of groundnut and soybean were adjusted as intercrops in between the pair of maize rows. According to the recommended dose of NPK i.e.80-60-40 kgha^{-1} for maize and 20-60-40 kgha^{-1} for intercrops were supplied through Urea, single super phosphate (SSP) and murate of potash (MOP), respectively. For groundnut and soybean, entire dose of nitrogen as per the treatment, along with the full doses of phosphorous and potassium were applied as basal at the time of sowing on the basis of their plant population. While for maize, 50% of nitrogen along with the recommended doses of phosphorous and potassium was incorporated in the soil as basal application at sowing and the remaining amount of nitrogen was given equally in two split doses at knee high and tasselling stage of the crop growth, respectively. The land was ploughed with power tiller and then harrowed and planked one week later. Line sowing was done upto a depth of 5 cm by a furrow opener. A plant to plant distance of 20 cm and 15 cm was maintained for maize and intercropped legumes respectively. The intercultural operations like weeding, thinning, etc. and insect pest control measures were taken as and when required. For the record of various observations five plants were selected randomly from each treatment and labelled. Data so collected were subjected to statistical analysis (Gomez and Gomez 1984) [10].

Table 1: Treatment imposition

S.no.	Treatments	Cropping systems	Description	Total N applied (kgha^{-1})
1.	G_0	Maize+ groundnut	without N	0+0
2.	S_0	Maize + soybean	without N	0+0
3.	G_1	Maize+ groundnut	75% RDN of maize to maize + 50% RDN of IC to IC	60+10=70
4	S_1	Maize + soybean	75% RDN of maize to maize + 50% RDN of IC to IC	60+10=70
5.	G_2	Maize+ groundnut	RDN of maize to maize	80+0=80
6.	S_2	Maize + soybean	RDN of maize to maize	80+0=80
7	G_3	Maize +groundnut	75% RDN of maize to maize + 25% RDN of maize to IC	60+20=80
8.	S_3	Maize + soybean	75% RDN of maize to maize + 25% RDN of maize to IC	60+20=80
9.	G_4	Maize+ groundnut	RDN of maize to maize + 50% RDN of IC to IC	80+10=90
10.	S_4	Maize + soybean	RDN of maize to maize + 50% RDN of IC to IC	80+10=90
11.	G_5	Maize+ groundnut	RDN of maize to maize + RDN of IC to IC	80+20=100
12.	S_5	Maize + soybean	RDN of maize to maize + RDN of IC to IC	80+20=100

N.B: N - Nitrogen, RDN -Recommended dose of nitrogen and IC - Intercropping

Results and Discussion

Maize

Grain yield: Table 2 revealed that nitrogen levels exhibited highly significant effect on grain yield of maize where the maximum value was associated with 75% RDN of maize to maize + 25% RDN of maize to IC over control. The highest grain yield of maize with the said treatment could be attributed to better growth and yield attributes attainment, moderate yield potential of the variety used for investigation, minimum competition and additional N supply through BNF from associated intercrops. The results further indicated that grain yield of maize was not significantly affected by intercropped treatments.

The interaction between intercropped legumes and different N dozes was significant statistically. Table 2 (a) showed that groundnut intercropped maize produced maximum maize grain yield (5.1 t ha^{-1}) with 100% RDN of maize to maize +100% RDN of IC to IC treatment while soybean intercropped maize yielded maximum grains (6.80 t ha^{-1}) when N was supplied as 75% RDN of maize to maize +25% RDN of maize to IC and this grain yield was significantly higher over maize grain yield at all N levels with maize+groundnut intercropping. At other N levels, difference between groundnut and soybean intercropped maize was at par. A portion of increased N fertilization to soybean and groundnut was possibly taken by maize due to its extensive surface feeder root system resulted in its better earlier growth and yielding ability. The results are in agreement with Giller and Wilson, (1991) [9] and Layek *et al*. (2014) [19].

Biological yield: The highest grain and stover yields at 75% RDN of maize to maize +25% RDN of maize to IC over control also resulted in maximum biological yield, since it is the summation of grain and stover yield. Significantly, less biological yield in no N treatment can be justified to significantly more grain and stover yield in all N supplied treatments over no N treatment. Stover yield of maize was comparatively higher when intercropped with soybean than groundnut intercropping and the same was reported by Mandal *et al.* (2014) [20]. Harvest index (HI) in maize was not significantly influenced by intercropping as well as bynitrogen level.

Table 2: Effect of intercropped legumes and variable RDN on yield parameters of maize

Treatment	Grain yield (tha^{-1})	Stover yield (tha^{-1})	Biological yield (tha^{-1})	Harvest Index
Intercropped legumes				
Groundnut	3.9	6.0	9.9	39.5
Soybean	4.1	7.1	11.3	36.4
SEm±	0.2	0.3	0.4	1.3
CD(P=0.05)	NS	0.9	1.3	NS
N-management				
$Maize_{0N}$ + IC_{0N}	2.2	3.8	6.0	36.4
$Maize_{60N}$ +IC_{10N}	3.7	5.9	9.6	38.2
$Maize_{80N}$ +IC_{0N}	3.9	8.2	12.2	33.3
$Maize_{60N}$ +IC_{20N}	5.3	8.4	13.7	37.9
$Maize_{80N}$ +IC_{10N}	4.4	6.7	11.1	39.6
$Maize_{80N}$ +IC_{20N}	4.6	6.4	10.9	42.4
SEm±	0.3	0.6	0.7	2.2
CD(P=0.05)	0.9	1.6	2.2	NS

Table 2(a): Interaction between intercropped legumes and variable RDN on maize grain yield (tha^{-1})

	Nitrogen management					
Intercropped legumes	**$Maize_{0N}$+IC_{0N}**	**$Maize_{60N}$ +IC_{10N}**	**$Maize_{80N}$ +IC_{0N}**	**$Maize_{60N}$ +IC_{20N}**	**$Maize_{80N}$ +IC_{10N}**	**$Maize_{80N}$ +IC_{20N}**
Groundnut	2.5	3.9	4.2	3.7	4.1	5.1
Soybean	1.9	3.5	3.8	6.8	4.7	4.2
SEm±	0.4					
CD(P=0.05)	1.3					

Nutrient Uptake: In present investigation (Table 3), N, P and K content in grain and straw of maize did not differ significantly due to intercropped legumes however; these uptakes were relatively higher in soybean intercropped maize as compared to groundnut intercropped maize. On another side, all these uptakes varied significantly due to application of variable RDN. Application of 75% RDN of maize to maize + 25% RDN of maize to IC resulted in maximum uptake of N by grain and stover of maize and their total as well. However, maximum grain and stover yield accompanied with higher N content both in grain and straw is the reason for observance of maximum total N uptake in grain and stover of maizeat the said N treatment. Since, total N uptake is the sum of grain and stover N uptake. Adhikary *et al.* (2005) also observed a significant increase in nutrient uptake in maize with increasing N levels in maize+ground nutintercropping. At zero level of N, maize N uptake was substantially lower as compared to treatments provided with N.

Table 3: Effect of intercropped legumes and variable RDN on nutrient uptake ($kgha^{-1}$) of maize

	N uptake			**P uptake**			**K uptake**		
Treatment	**Grain**	**Stover**	**Total**	**Grain**	**Stover**	**Total**	**Grain**	**Stover**	**Total**
Intercropped legumes									
Groundnut	86.3	46.1	132.3	22.2	10.0	32.2	17.9	50.8	68.7
Soybean	92.6	56.2	148.8	23.4	12.2	35.5	19.4	62.4	81.8
SEm±	4.8	3.0	7.2	1.1	0.6	1.6	0.9	17.5	4.0
CD(P=0.05)	NS	8.9	NS	NS	1.8	NS	NS	NS	11.8
N-management									
$Maize_{0N}$ + IC_{0N}	32.8	22.8	55.6	9.8	5.8	15.6	8.0	29.1	37.1
$Maize_{60N}$ +IC_{10N}	71.8	45.0	116.8	14.9	7.9	22.9	14.2	46.2	60.4
$Maize_{80N}$ +IC_{0N}	75.2	60.9	136.1	22.7	15.5	38.2	17.6	76.47	94.1
$Maize_{60 N}$ +IC_{20N}	108.8	68.2	177.0	25.0	13.3	38.3	19.9	65.5	85.5
$Maize_{80N}$+IC_{10N}	85.7	51.6	137.2	21.3	10.9	32.2	18.3	57.7	76.1
$Maize_{80N}$+IC_{20N}	89.3	47.7	137.0	24.7	11.1	35.8	18.8	53.8	72.6
SEm±	8.0	4.6	11.0	1.8	0.9	2.5	1.6	5.1	6.1
CD(P=0.05)	23.5	13.6	32.4	5.2	2.8	7.2	4.9	14.8	17.8

Intercrops

Grain yield: The yield studies in intercrop legumes (Table 4) were done for pod yield, grain yield, stover yield and biological yield. Variation of RDN caused a significant effect only on grain yield of intercrops and 100% RDN of maize to maize + 50% RDN of IC to IC produced maximum grain yield being on par with 75% RDN of maize to maize + 50% RDN of IC to IC and 100% RDN of maize to maize + 0 RDN of IC to IC but significantly higher over the grain yield recorded at all remaining N doses. It revealed that almost 50% N requirement of legume could be saved when grown as intercrop with high N requiring crop like maize thus, accelerating the BNF activity of legumes. At par difference in stover and biological yield also indicated no advantage of N application beyond 50% of recommended rate as legumes are able to meet their N requirement through their nitrogen fixing ability. Ahmed and Gunasena 1979 and Ofori and Stern 1986) also find similar yield trends.

Biological Yield: Intercrop groundnut recorded significantly higher grain and biological yield over intercrop soybean except the pod yield which was at par. Significantly, high harvest index accompanied with significantly more biological yield and comparatively more shelling percentage resulted in higher economic yield in groundnut over soybean observed as pod and grain yield and also left significantly more stover in groundnut after removal of grains.

Harvest index (HI) of the intercrops differed significantly by intercropping and groundnut recorded high HI (25.85%) over soybean (22.85%) thus, indicating better adaptability of groundnut between the rows of maize. No significant difference in HI however, observed due to varying doses of N.

Nutrient uptake: Maize intercropped groundnut removed significantly more quantity of total P and K and relatively more amount of total N (with at par difference) than maize intercropped soybean(Table5).Though N, P and K content was observed more in soybean grains their greater uptake by groundnut grains was the result of significantly higher grain yield associated with thelater. Hongchun *et al*. 2013; Adhikary *et al*. 2005 [2] also reported similar findings on difference in nutrient uptake of groundnut and soybean when intercropped with maize. Significant difference in grain yield of intercroplegumes accompanied with higher nutrient content was responsible for significant difference in grain nutrient uptake due to variable N application. Higher grain and stover yield was associated with 100% RDN of maize to maize + 50% RDN of IC to IC and 100% RDN of maize to maize +0% RDN of IC to IC, all the nutrient uptakes were also higher with these two N treatments in maize-legume intercropping system. Giller (2001) [8] also observed similar reasons for differences in nutrient uptake of groundnut and soybeans in maize-legumeintercropping due to variable N application.

Table 4: Effect of intercropped legumes and variable RDN on yield parameters (tha^{-1}) of intercropped legumes

Treatment	Pod yield	Grain yield	Stover yield	Biological yield	Harvest index
Intercropped legumes					
Groundnut	2.2	1.6	6.4	8.7	25.9
Soybean	2.1	1.4	5.0	6.5	22.9
SEm±	0.1	0.1	0.3	0.3	0.7
CD(P=0.05)	NS	0.2	0.7	0.9	0.7
N-management					
$Maize_{0N}$ +IC_{0N}	2.1	1.5	5.3	6.9	24.9
$Maize_{60N}$ +IC_{10N}	2.2	1.6	5.8	7.7	24.4
$Maize_{80N}$ +IC_{0N}	2.2	1.6	6.3	8.2	22.7
$Maize_{60N}$ +IC_{20N}	1.9	1.4	5.2	6.9	24.3
$Maize_{80N}$ +IC_{10N}	2.4	1.8	6.5	8.7	25.6
$Maize_{80N}$ +IC_{20N}	1.9	1.3	5.2	6.9	24.3
SEm±	0.2	0.1	0.4	0.5	1.2
CD(P=0.05)	NS	NS	NS	NS	NS

Table 5: Effect of intercropped legumes and variable RDN on nutrient uptake (kgha^{-1}) of intercropped legumes

Treatment	N			P			K		
	Grain	Stover	Total	Grain	Stover	Total	Grain	Stover	Total
Intercropped legumes									
Groundnut	58.94	86.62	145.57	12.31	28.23	40.54	13.53	106.09	119.19
Soybean	86.32	76.46	162.78	23.64	19.04	42.69	11.93	52.46	64.38
SEm±	2.95	4.24	6.34	0.74	1.21	1.78	0.53	3.66	3.95
CD(P=0.05)	8.66	NS	NS	2.17	3.55	NS	1.56	10.74	11.59
N-management									
$Maize_{0N}$ + IC_{0N}	66.27	76.30	142.58	17.35	22.19	39.54	11.82	65.78	77.60
$Maize_{60N}$+IC_{10N}	71.61	64.64	136.25	21.65	28.49	50.15	13.06	80.78	93.84
$Maize_{80N}$ +IC_{0N}	77.25	103.30	180.56	18.51	24.64	43.15	15.53	99.34	114.84
$Maize_{60N}$+IC_{20N}	65.32	79.79	145.11	15.54	20.83	36.37	10.31	61.35	71.52
$Maize_{80N}$+IC_{10N}	91.63	88.69	180.32	20.06	25.94	46.01	15.87	101.38	117.08
$Maize_{80N}$+IC_{20N}	63.74	76.52	140.25	14.73	19.72	34.46	9.79	65.49	76.21
SEm±	5.11	7.34	10.98	1.28	2.10	3.09	0.92	6.34	6.84
CD(P=0.05)	14.99	21.53	32.20	3.76	NS	9.05	2.70	18.60	20.07

Changes in Fertility status of soil

Residual soil available N was significantly higher in maize+groundnut over maize+soybean intercropping (Table 6). Higher BNF by maize intercropped groundnut due to better nodulation and biomass growth left significantly more N in soil even after relatively higher N uptake. However, significantly high SMBC in maize+soybean, indicating higher energy source as evidenced by more organic carbon and possibly less competition than the intercrop groundnut. Jensen 2006 [15], Ullah *et al.* 2013 [29] also observed similar difference in soil properties due to different leguminous intercrop species. However, all fertilized N treatments recorded significantly higher organic carbon over no N treatment (1.68%). Higher availability of available N in soil with no N level was the result of relatively more N fixation by legumes as indicated by higher biological yield associated with this treatment and lowest uptake due to poor grain yield of maize while lowest availability in treatment 100% RDN of maize to maize + 0% RDN of IC to IC could be explained for higher N uptake by cereal maize due to relatively higher grain and stover yield. Significantly, lower availability of P in treatment 100% RDN of maize to maize + 0% RDN of IC to IC and 100% RDN of maize to maize + 100% RDN of IC to IC was possibly due to poor activity of phosphorus solubilizing microorganisms as evidenced by significantly lower SMBC and adverse effect of excess N and relatively more uptake by maize and intercrop legumes. Results further revealed the complementary interaction for soil available N even with full RDN to maize which may be due to more availability of N in soil through symbiotic BNF by legumes. Fustec *et al*. 2010 and Kumbhar *et al.* 2007 [7, 17] also observed the beneficial effect of intercrop legume and N management practices on residual soil fertility.

Table 6: Effect of intercropped legumes and variable RDN on soil biochemical properties

Treatment	pH	Organic carbon (%)	N (kgha^{-1})	P (kgha^{-1})	K (kg ha^{-1})	SMBC (μg g^{-1})
Intercropped legumes						
Groundnut	5.1	1.8	285.2	18.5	142.9	222.9
Soybean	4.9	1.9	258.6	18.1	140.8	242.9
SEm±	0.1	0.1	6.9	0.3	1.7	3.3
CD(P=0.05)	NS	NS	20.4	NS	NS	9.7
N-management						
Maize$_{0N}$+ IC$_{0N}$	4.9	1.7	298.1	18.4	148.2	235.9
Maize$_{60N}$ +IC$_{10N}$	4.9	1.967	279.2	22.3	141.0	240.6
Maize$_{80N}$ +IC$_{0N}$	5.1	1.9	222.6	20.2	139.0	223.7
Maize$_{60N}$ +IC$_{20N}$	5.1	2.0	282.2	14.3	140.3	215.7
Maize$_{80N}$ +IC$_{10N}$	5.2	1.7	267.1	20.2	141.8	236.8
Maize$_{80N}$ +IC$_{20N}$	4.8	1.9	282.4	14.6	140.7	244.9
SEm±	0.1	0.1	12.0	0.5	2.9	5.7
CD(P=0.05)	NS	0.2	35.3	1.5	NS	16.8

Economics

Economic return was relatively higher in maize+ groundnut (Table 7). The MEY was significantly the highest in maize+ groundnut as a result of comparatively three and 1.5 times more minimum support price of groundnut pods over maize and soybean grains, respectively, accompanied with relatively higher economic yield in groundnut over soybean (Table 5). Such performances were also observed by Bhagat *et al.* (2006) [6] and Seran and Brintha (2010) [26] in maize+groundnut intercropping. 100% RDN of maize to maize + 50% RDN of IC to IC recorded the highest gross return, net return and B: C ratio followed by 75% RDN of maize to maize + 25% RDN of maize to IC and the reason was production of significantly higher MEY (Meena *et al.* 2006) [21] on these two N treatments which was at par between them (Amanullah and Shah 2010) [4]. In all cases, zero N level gave significantly least values of economic return as a result of lowest MEY at this treatment due to very poor yield of maize grains since maize could not realize its full yield potential in absence of N which creates an intense competition for N sources with intercrop legumes which was not affected by absence of fertilizer aided by their nitrogen fixing ability. MEY increased with increased levels of N application because of higher productivity of maize and less negative effects on yield of legumes with increasing levels of N fertilizers.

Interaction effect (Table 7a) revealed that maize intercropped groundnut gave significantly higher net return and B:C ratio over maize + soybean at all N treatments except at 75% RDN of maize to maize + 25% RDN of maize to IC when the excess of difference in both parameters was at par. No N treatment gave least net return and B: C ratio in both the intercropping systems which could be best explained to significantly lowest MEY observed with this treatment.

Conclusions

On the basis of the above said findings, following conclusions could be drawn:

1. Application of treatment 100% RDN of maize to maize + 50% RDN of IC to IC and 75% RDN of maize to maize + 25% RDN of maize to IC was statistically at par and gave maximum MEY, Net return.
2. MEY recorded under 75% RDN of maize to maize + 50% RDN of IC to IC was at par with 100% RDN of maize to maize + 100% RDN of IC to IC, thus indicating that even with 30 kg less N rate, the productivity is similar with 100% RDN of maize to maize + 100% RDN of IC.
3. Maize+groundnut intercropping gave significantly higher maize equivalent yield and left residual N in soil over maize+soybean intercropping.
4. Intercropped legumes gave higher pod and grain yield only upto 50% RDN of IC to IC.

Table 7: Effect of intercropped legumes and variable application of RDN on economic return

Treatment	Gross return (Rs.ha^{-1})	Net return (Rs. ha^{-1})	B:C ratio	Maize equivalent yield (tha^{-1})
Intercropped legumes				
Groundnut	139.9	83.5	2.5	10.7
Soybean	85.7	32.9	1.6	6.5
SEm±	3.3	3.3	0.1	0.3
CD(P=0.05)	9.8	9.8	0.2	0.8
N-management				
Maize$_{0N}$ +IC$_{0N}$	84.6	30.1	1.5	6.5
Maize$_{60N}$ +IC$_{10N}$	113.1	58.5	2.1	8.6
Maize$_{80N}$ +IC$_{0N}$	110.4	55.8	2.0	8.4
Maize$_{60N}$ +IC$_{20N}$	122.6	68.0	2.2	9.4
Maize$_{80N}$ +IC$_{10N}$	130.2	75.6	2.4	9.9
Maize$_{80N}$ +IC$_{20N}$	116.1	61.5	2.1	8.9
SEm±	5.8	5.8	0.1	0.4
CD(P=0.05)	16.9	16.9	0.3	1.3

Table 7(a): Interaction between intercropped legumes and variable RDN application on net return ($Rs.ha^{-1}$)

	Nitrogen management					
Intercropped legumes	**$Maize_{0N}$ +IC_{0N}**	**$Maize_{60N}$ +IC_{10N}**	**$Maize_{80N}$ +IC_{0N}**	**$Maize_{60N}$ +IC_{20N}**	**$Maize_{80N}$ +IC_{10N}**	**$Maize_{80N}$ +IC_{20N}**
Groundnut	58.4	98.1	82.4	73.3	94.5	94.5
Soybean	1.7	18.9	29.2	62.8	56.5	28.4
SEm±	8.2					
CD(P=0.05)	23.9					

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