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Effect of Land Configuration, Irrigation and INM on Quality, Nutrient Content and Uptake of Indian Bean (var. GNIB-21)

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A B S T R A C T

A field experiment was conducted on clay soil (*Vertic ustochrepts*) of Soil and Water Management Farm of Navsari Agricultural University, Navsari during *rabi* season of 2015-16 on “Effect of land configuration, irrigation and INM on quality, nutrient content and uptake of Indian bean (var. GNIB -21)”. In all, twelve treatment combinations consisting of two levels each of land configuration (L1: Raised bed and L2: Flatbed), irrigation (I1: 0.4 and I2: 0.6 IW/CPE ratio) and three levels of integrated nutrient management [F1= 100% RDF, F2= 75% RDF + 5t BC/ha + bio fertilizer (*Rhizobium* + PSB) and F3= 50% RDF + 5t BC/ha + bio fertilizer (*Rhizobium* + PSB)] were tried in split plot design with three replications. The results revealed that protein content as well as nutrients content in seed and stover was not influenced significantly due to main effect of land configuration, irrigation and INM as well as their interactive effects. While the protein yield in seed was affected significantly due to land configuration treatment. Significantly higher protein yield in seed and stover were recorded with raised bed configuration as compared to flat bed sowing. In case of INM treatment, only protein yield in seed was affected significantly. Here, treatment F_2 and F_3 remained at par with each other and both were significantly superior over treatment F_1. Uptake of all the nutrients by seed as well as stover was significantly higher in raised bed configuration in comparison to control. Irrigation scheduling did not alter the nutrient uptake by seed and stover. In case of INM treatments, only uptake of nutrient by seed was influenced significantly, in all the cases treatment F_2 and F_3 remained at par with each other and both were performed better than treatment F_1.

Introduction

The Indian bean *(Dolichos lablab* L.) belongs to the family *Leguminosae* and considered as nutritious vegetables as they contain high amount of vegetable protein, besides carbohydrates and vitamins. The crop has multipurpose use. The green tender pods are used as vegetable and also as the dry seeds. It is one of the excellent pod vegetable crops grown in India. The green pods and tender leaves are popular vegetables. Its fresh green pod contain 86.1% moisture, 3.8% protein, 6.7% carbohydrates, 0.75% fat, 0.9% mineral matter and vitamin-A 312 I.U. (Singh *et al*. 2004). In south Gujarat, It is mostly grown during *rabi* season in field vacated by *kharif* crops like paddy. Recommended / cultivated field bean varieties like G.wal-1 and N-wal-125-36 and local vegetable purpose varieties like *katargram* and *kapasia* are grown by the farmers. Apart from there, new variety GNIB -21 found most promising for vegetable purpose due to its short stature plants, early picking and short duration. It became popular among the farmer of South Gujarat due to it's suitability as intercrop also, to improve quality of any crops, timely and proper management practices has very much importance. Low productivity of crop as well as poor quality are mainly due to adoption of improper agrotechniques such as method of sowing, irrigation and nutrient management. Hence, to study the effect of different agrotechniques on quality and nutrient content and uptake by Indian bean, present experiment was planned.

Materials and Methods

The experiment was conducted on Soil and Water Management Research Unit Farm (SWMRU), Navsari Agricultural University, Navsari during *rabi* season of 2015-16. These soils are locally known as "deep black soil''. The colour of dry soil is dark brown and textured clay with medium in organic carbon (0.52 %), low in available nitrogen (67.0 kg/ha), high in phosphorus (186.1 kg/ha) and high in available potassium (588.1 kg/ha). Treatment combinations consisting of two levels each of land configuration (L_1: Raised bed and L_2: Flatbed),irrigation (I_1: 0.4 and I_2: 0.6 IW/CPE ratio) and three levels of integrated nutrient management (F_1= 100% RDF (20:40:00 NPK kg/ha), F_2= 75% RDF + 5tBC/ha + bio fertilizer (*Rhizobium* + PSB) and F_3= 50% RDF + 5t BC/ha+ bio fertilizer (*Rhizobium* + PSB)) were tried in split plot design where land configuration and irrigation schedules were allocated to main plots while integrated nutrient management system were assigned to sub plots and replicated thrice. Indian bean cultivar GNIB-21 was sown in 6^{th} November with aforesaid treatment and their combinations with 45×10cm (For L_1) & 30×10cm (For L_2) row to row and plant to plant spacing. Crop was fertilized and irrigated as per treatments. For L_1 and L_2 treatments depth of irrigation was kept 60 mm and 40 mm, respectively. First common irrigation at 80 mm depth was given to all the treatments at the time of sowing for uniform germination. Thinning and weeding were done as per requirement and harvesting was done when crop was fully matured . Random samples of seed and stover each net plot area were collected for chemical analysis . The samples were oven dried at 60℃ for 24 hours, powdered by mechanical grinder and analyzed for respective nutrient content using following procedures.

Particular	Procedure used	Reference
Nitrogen (%)	Modified Kjeldahl's method	Jackson (1973)
Phosphorus (%)	Vanadomolybdo phosphoric acid yellow color method	Jackson (1973)
Potassium (%)	Flame photometric method	Jackson (1973)

$$\text{Nutrient uptake/protein yield } (\text{kg ha}^{-1}) = \frac{\text{Content (\%) X Dry matter yield}}{100}$$

Protein content in the seed and stover were computed by multiplying nitrogen content with factor 6.5. The uptake values of seed and stover of macronutrients as well as protein yield were calculated by using following formula and were expressed as kg ha^{-1} and was subjected to statistical analysis as per method suggested by Panse and Sukhatme (1967).

Results and Discussion

Effect of different treatment on quality

Protein content in seed and stover were not altered due to main as well as interactive effect of land configuration, irrigation and INM (Table 1). While protein yield in seed was affected significantly due to individual effect of land configuration and INM as well as interactive effect of land configuration × irrigation (Fig. 1). Raised bed sowing registered significantly higher protein yield (233 kg/ha) in seed as compared to flatbed sowing. Raised bed configuration provides good aeration and drainage condition that might stimulate root growth and thereby increase uptake of N and ultimately resulted into higher protein yield. In case of INM treatments, treatment F_2 and F_3 with 234 and 224 kg/ha of protein yield in seed, respectively remained at par with each other and both were significantly superior over treatment F_1, which registered 192 kg/ha of protein yield in seed. In F_2 and F_3 treatment bio compost and biofertilizer were used that might have increased the N uptake and ultimately protein yield also increased. With respect to protein yield in stover, only the individual effect of land configuration and interaction effect of land configuration × irrigation were found to be significant. Between to land configuration treatment raised bed sowing (566 kg/ha) performed better than flatbed sowing (453 kg/ha). In case L×I interaction treatment $L_2 \times I_1$ (Raised bed × 0.4 IW/CPE ratio) out yielded rest of the treatment by registering significantly higher protein yield of 250 and 627 kg/ha, in seeds and stover of Indian bean, respectively. Here, crop was sown on raised bed and irrigation was given at 0.4 IW/CPE ratio that met the requirement of Indian bean. Shinde *et al.,* (2000) from Rahuri also reported higher protein yield in chickpea with ridge and furrow method of sowing and Patel *et al.*, (2009) from South Gujarat in chickpea with ridges and furrow method of sowing found significantly better with respect to seed and straw yield with better quality of chickpea.

Effect of different treatments on nutrient content and uptake of nutrients

Effect of land configuration

The content of N, P and K were separately determined from seed and stover of Indian bean. The effect of land configuration on N, P and K content in stover as well as in seed of Indian bean were not found to be significant, whereas, uptake of all the three nutrients found to be significant for seed and stover (Table 2). In all the cases raised bed configuration found significantly superior over flatbed sowing. The seed as well as stover yield were significantly higher under raised bed configuration in comparison to flatbed sowing (Table 2). This implies that the nutrient uptake by seed and stover were governed by biomass yield rather than their content. On an average, increase in uptake of N by seed and stover with L_2 treatment were of the order of 14.01 and 19.95 percent respectively over flatbed sowing. The corresponding percentage P was 16.52 and K was 15.92.

Effect of irrigation

The main effect of irrigation was not pronounced on nutrient content as well as uptake by Indian bean. The biomass yield as well as nutrient content were not found to be significant. Ultimately, the uptake that governs either by content or by biomass yield was also found to be non-significant.

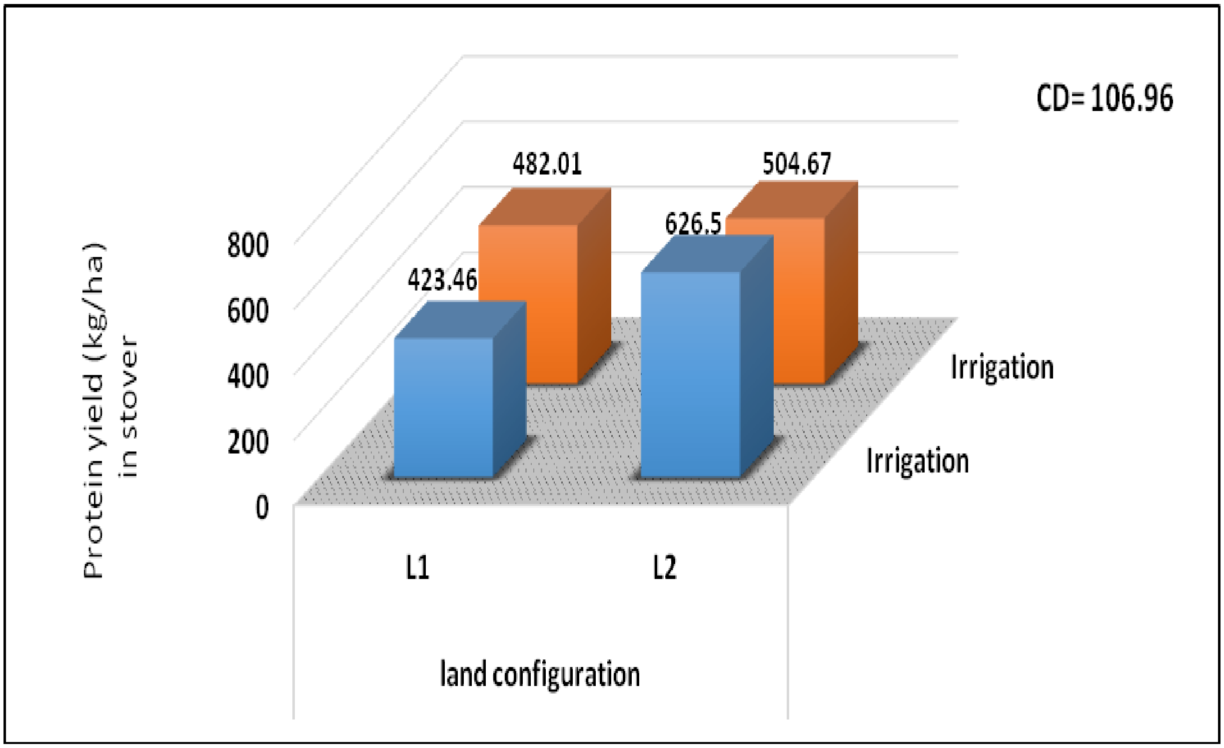
Table.1 Effect of land configuration, irrigation and INM on protein content (%) and protein yield (kg/ha) of Indian bean

Treatment	Protein content (%)		Protein yield (kg/ha)	
	Seed	**Stover**	**Seed**	**Stover**
Main plot				
A. Land configuration				
L_1 = flat bed	24	14	200	453
L_2 = Raised bed	24	15	233	566
S. Em. ±	0.31	0.40	4.47	21.85
C.D. at 5%	NS	NS	15.49	75.62
B. Irrigation				
I_1 = 0.4 IW/CPE	25	15	219	525
I_2 = 0.6 IW/CPE	24	14	214	493
S. Em. ±	0.31	0.40	4.47	21.85
C.D. at 5%	NS	NS	NS	NS
CV%	5.37	11.88	8.77	18.21
Sub plot				
Integrated Nutrient Management				
F_1 = 100%RDF (20:40:00 NPK kg/ha)	24	14	192	470
F_2 = 75%RDF + 5t BC/ha + bio fertilizer (PSB + Rhizobium)	24	14	234	524
F_3 = 50%RDF + 5t BC/ha + bio fertilizer (PSB + Rhizobium)	25	15	224	533
S. Em. ±	0.38	0.39	5.58	20.97
C.D. at 5%	NS	NS	16.75	NS
CV%	5.39	9.53	8.94	14.27
Significant interaction	-	-	L×I	L×I

Table.2 Effect of land configuration, irrigation and INM on N, P and K content and uptake in stover and seed of Indian bean

Treatment	Seed yield (kg/ha)	Stover yield (kg/ha)	N content (%)		P content (%)		K content (%)		N uptake (kg/ha)		P uptake (kg/ha)		K uptake (kg/ha)	
			Stover	Seed	Stover	Seed	Stover	Seed	Stover	Seed	Stover	Seed	Stover	Seed
Main plot														
A. Land configuration														
L_1 = flat bed	820	3344	2.17	3.92	0.22	0.50	2.04	0.11	72.44	32.03	7.39	4.07	68.54	0.92
L_2 = Raised bed	954	3779	2.39	3.90	0.23	0.50	2.16	0.11	90.49	37.25	8.58	4.79	81.53	1.08
S. Em. ±	15	100	0.06	0.05	0.006	0.008	0.05	0.001	3.50	0.72	0.24	0.09	1.39	0.02
C.D. at 5%	51	345	NS	NS	NS	NS	NS	NS	12.10	2.48	0.83	0.30	4.80	0.06
B. Irrigation														
I_1 = 0.4 IW/CPE	886	3591	2.32	3.96	0.23	0.50	2.05	0.11	84.00	35.07	8.14	4.41	74.23	1.01
I_2 = 0.6 IW/CPE	888	3532	2.24	3.86	0.22	0.50	2.15	0.11	78.93	34.21	7.83	4.45	75.84	0.99
S. Em. ±	15	100	0.06	0.05	0.006	0.008	0.05	0.001	3.50	0.72	0.24	0.09	1.39	0.02
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV%	7.11	11.88	11.88	5.37	12.25	7.19	11.01	3.09	18.21	8.77	12.80	8.37	7.84	7.78
Sub plot														
Integrated Nutrient Management														
F_1 = 100%RDF (20:40:00 NPK kg/ha)	787	3318	2.26	3.90	0.23	0.51	2.11	0.11	75.22	30.67	7.52	4.04	71.09	0.89
F_2 = 75%RDF + 5t BC/ha + bio fertilizer (PSB + Rhizobium)	966	3771	2.22	3.87	0.23	0.49	2.04	0.11	83.91	37.68	8.53	4.69	76.99	1.08
F_3 = 50%RDF + 5t BC/ha + bio fertilizer (PSB + Rhizobium)	908	3596	2.36	3.96	0.22	0.50	2.14	0.11	85.27	35.87	7.90	4.56	77.02	1.03
S. Em. ±	17	105	0.06	0.06	0.010	0.01	0.09	0.001	3.36	0.89	0.41	0.13	4.26	0.02
C.D. at 5%	50	315	NS	NS	NS	NS	NS	NS	NS	2.68	NS	0.40	NS	0.07
CV%	6.58	10.23	9.53	5.39	15.82	9.32	14.47	3.79	14.27	8.94	17.93	10.55	19.67	7.93
Significant Interaction	L × I	L × I	-	-	-	-	-	-	L×I	L×I	NS	L×I	L×I	L×I

Fig.1 Protein yield (kg/ha) in stover and seed influenced by interactive effect of land configuration and irrigation



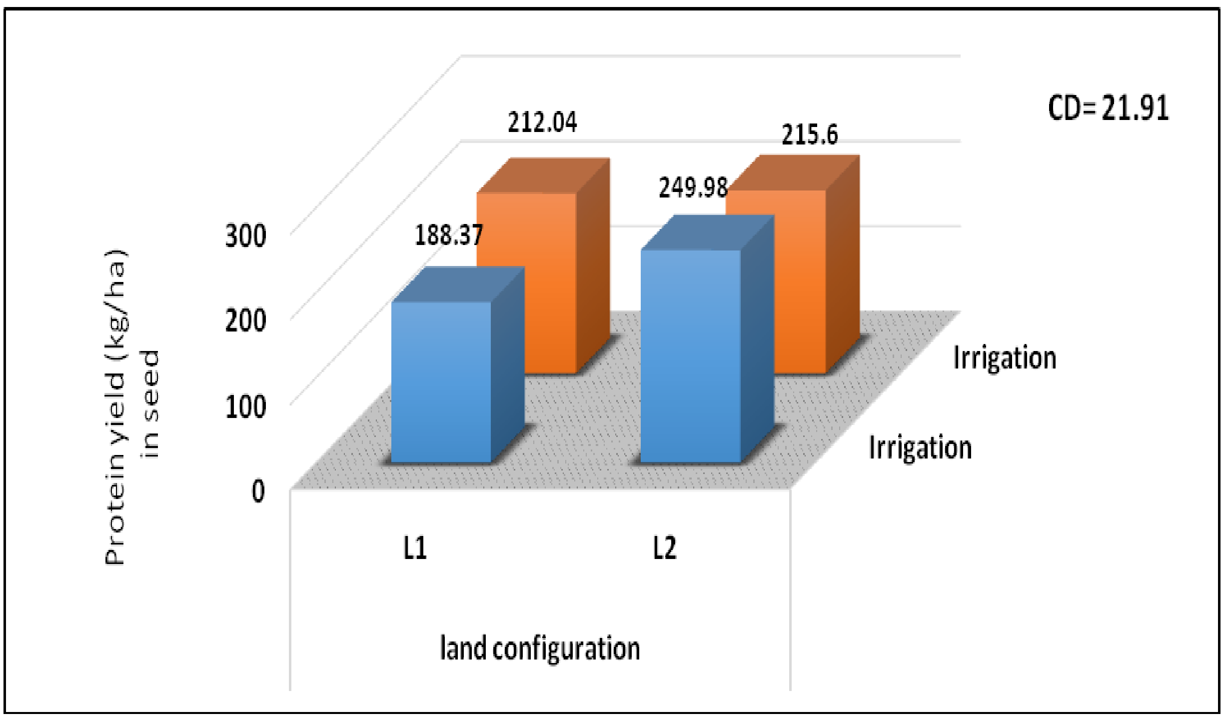
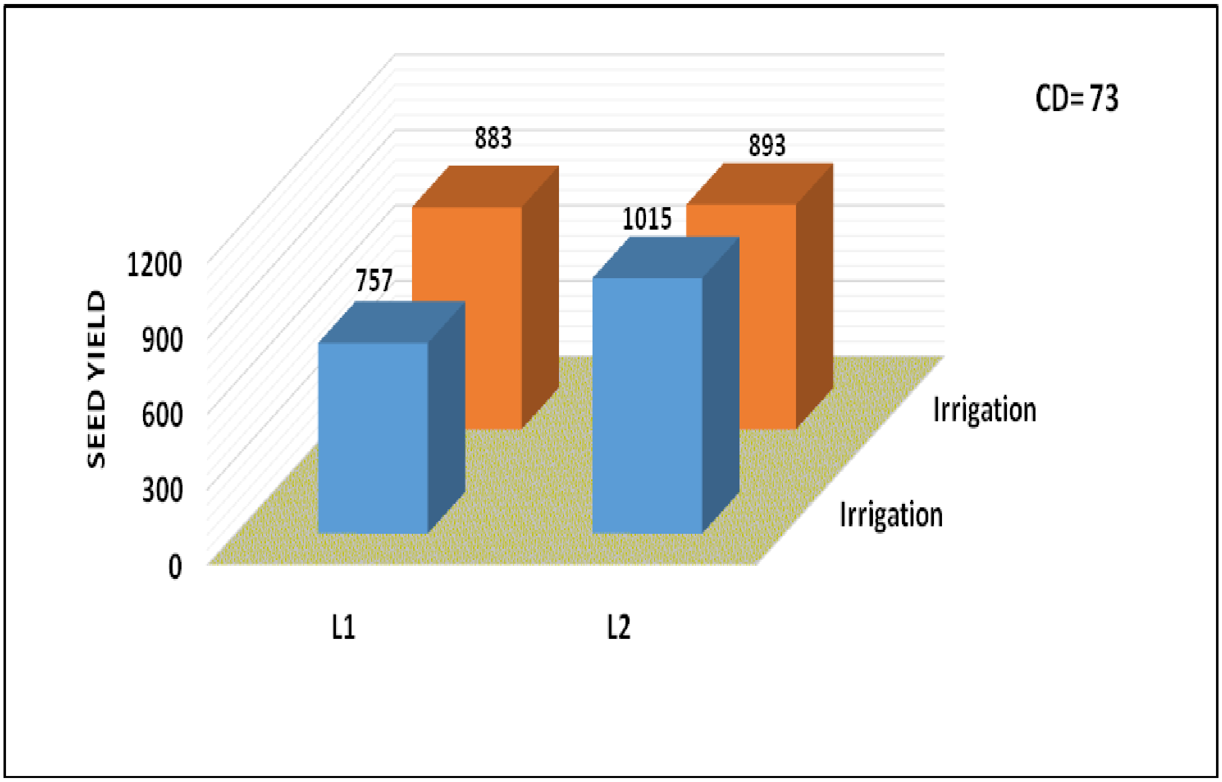


Fig.2 Seed and stover yield (kg/ha) influenced by interactive effect of land configuration and irrigation



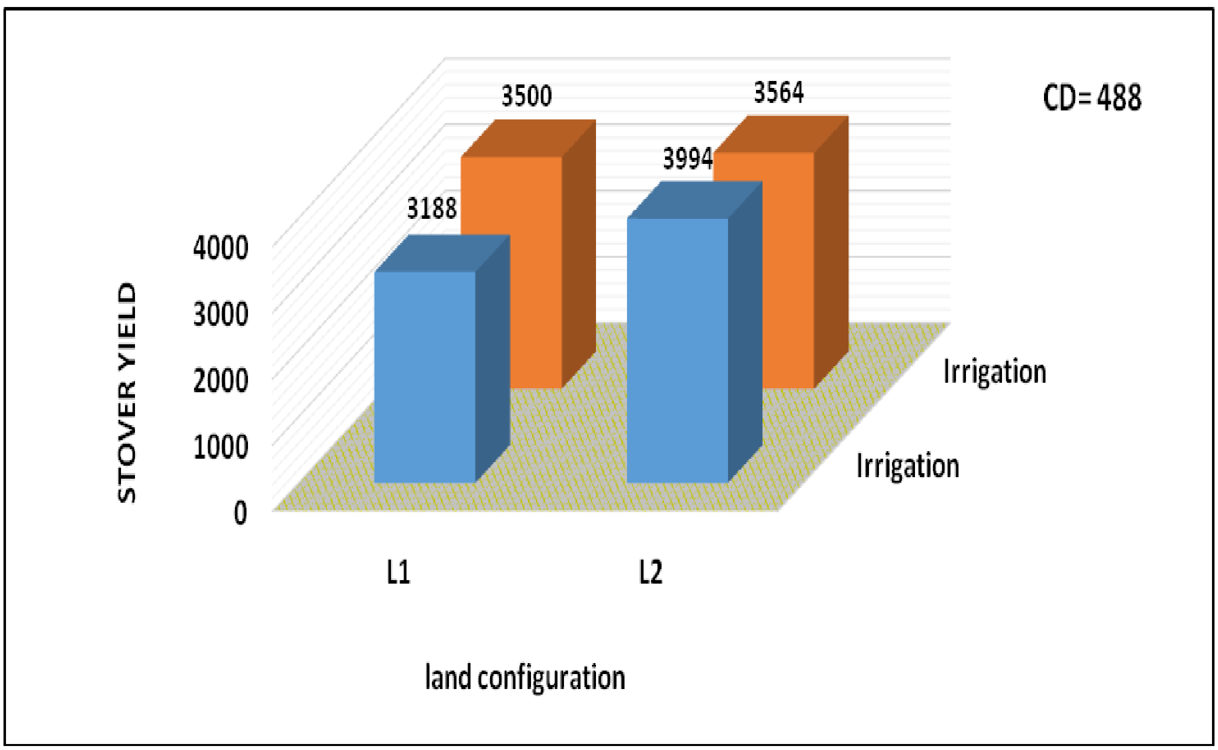
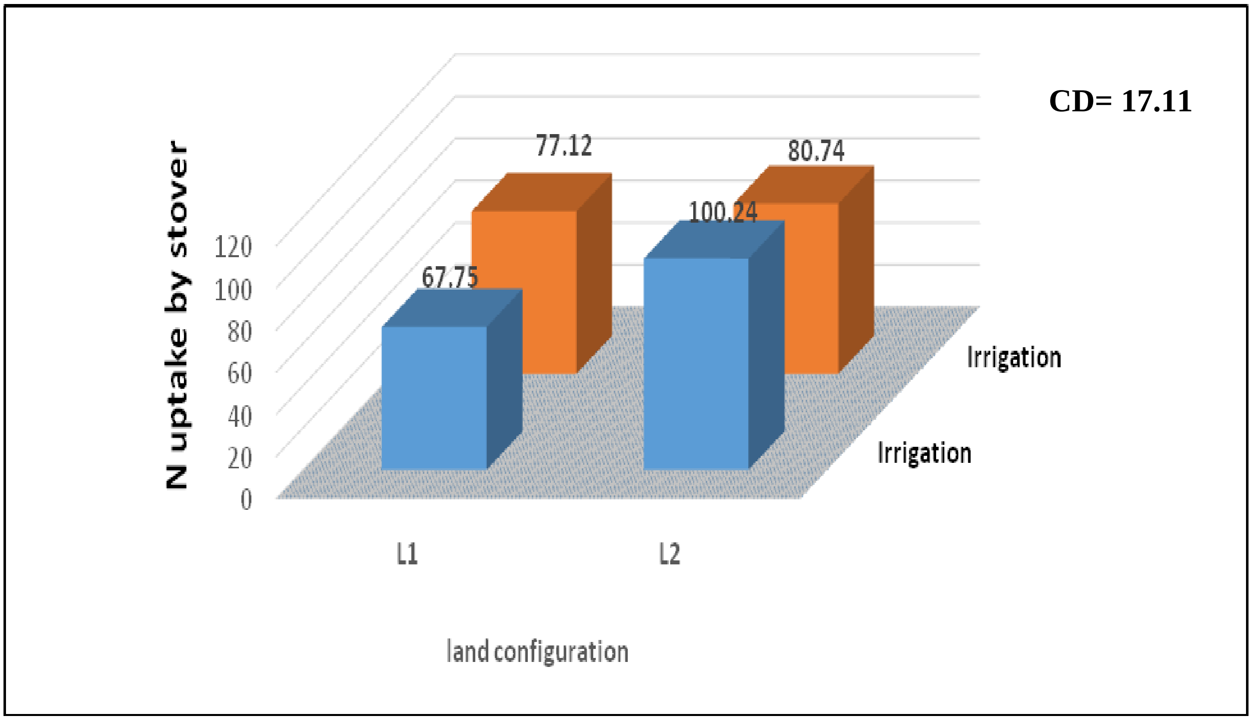


Fig.3 N uptake (kg/ha) in stover and seed influenced by interactive effect of land configuration and irrigation



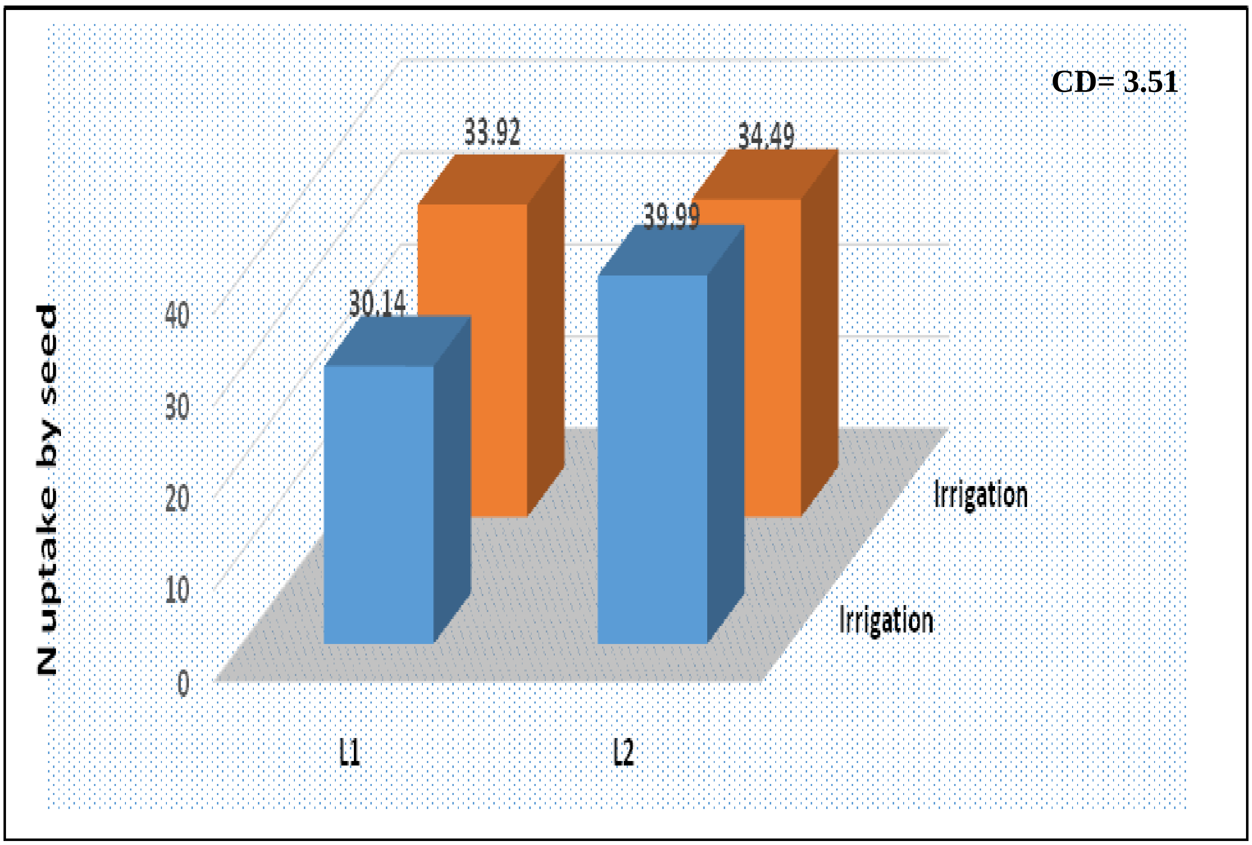


Fig.4 P uptake (kg/ha) in seed influenced by interactive effect of land configuration and irrigation

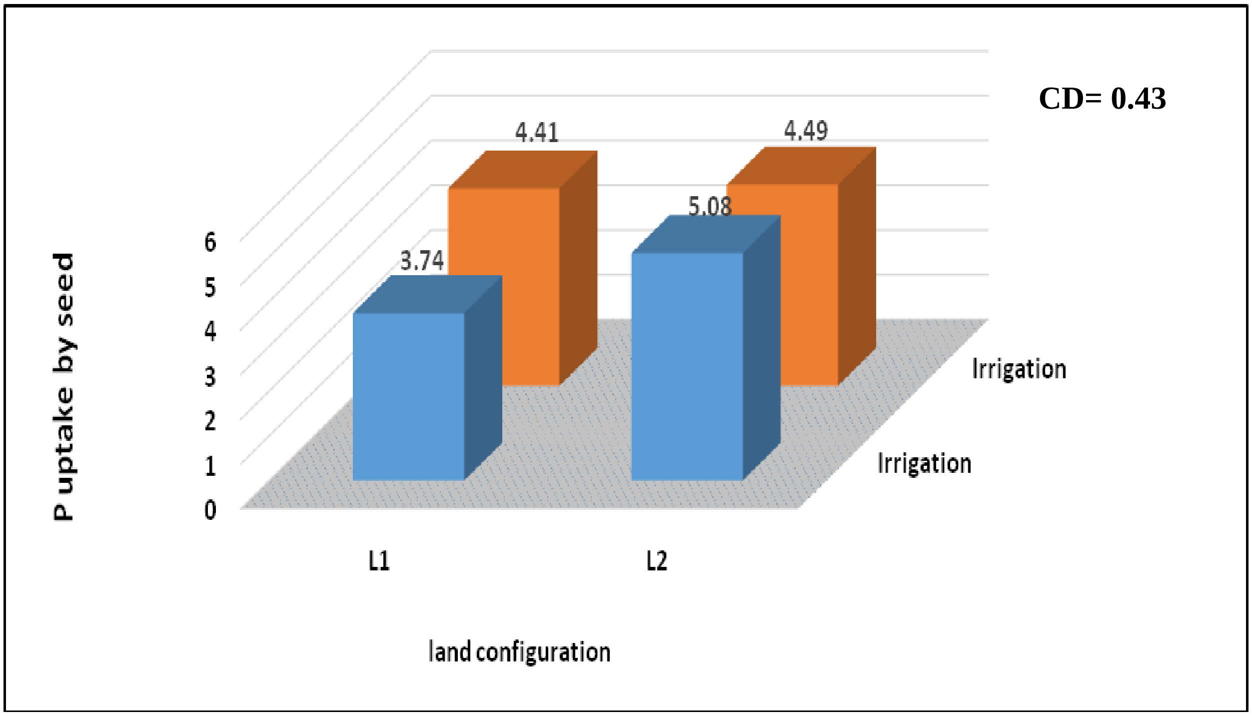
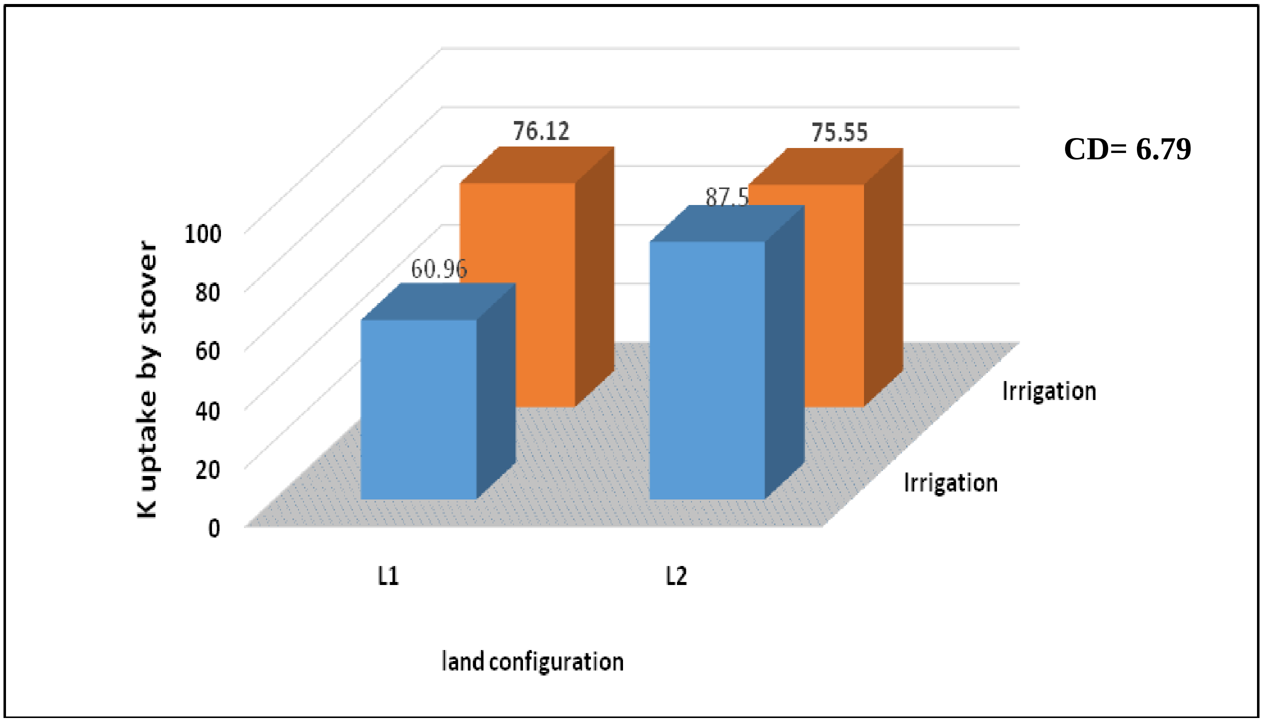
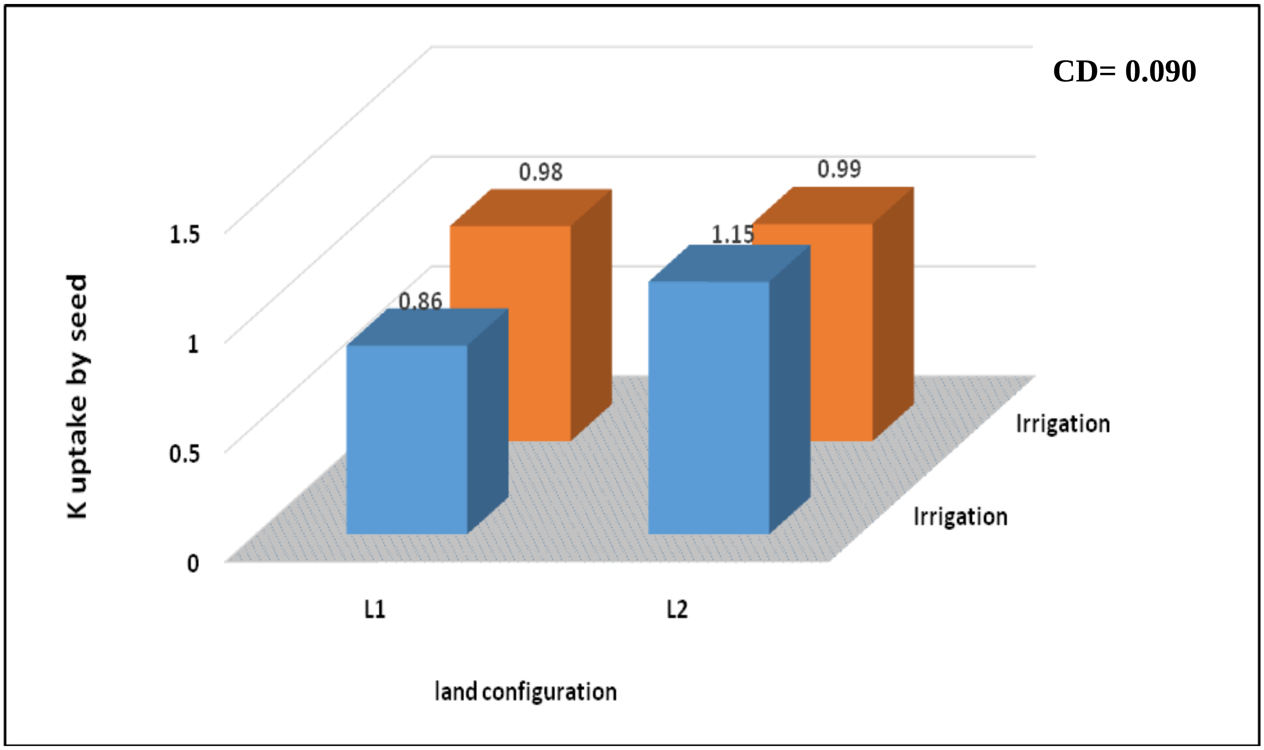


Fig.5 K uptake (kg/ha) in stover and seed influenced by interactive effect of land configuration and irrigation





Effect of INM

Nutrient content in seed and stover were not affected significantly due to individual effect of INM but uptake of all the nutrients by seed were influenced significant due to INM effect. In all the cases, treatment F_2 and F_3 remained at par with each other and both were recorded significantly higher uptake of nutrient than F_1. In F_2 and F_3 treatments biocompost and biofertilizer were applied, while in F_1 treatment only chemical fertilizers were used. This also implies that addition of organics and bio fertilizer might have improved nutrient availability and subsequently absorbed by plant and translocated to seeds.Singh *et al.*, (2007) in soybean, Wagadre *et al.*, (2010) in green gram.

Interaction effect

Nutrient content in seed and stover were not influenced significantly due to any of the interaction. But the uptake of all the nutrients by seed as well as stover was influenced significantly due to L × I interaction except K uptake by stover. In all the cases treatment L_2I_1 registered higher uptake of nutrients by seed and stover (fig 3, 4 & 5).Here, also the seed as well as stover yield were significantly higher in L_2I_1 treatment (fig 2). So that the uptake of nutrient were governed by biomass yield and ultimately higher uptake were recorded with L_2I_1 treatment.

It can be concluded from the results that for getting higher protein yield in seed and stover of Indian bean as well as for better utilization of nutrients, the crop should be sown on raised bed and irrigated at 0.4 IW/CPE ratio (Four irrigation at an interval at 19 days) along with adoption of integrated nutrient management system.

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