Fertilization Levels On Yield, Quality, Nutrient Uptake and Use Efficiency of Pigeon Pea [*Cajanus Cajana* (L.)] Varieties in *Alfisols* of Karnataka, India.

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Introduction

Protein rich Pigeon pea is second most important pulse crop of India after chickpea. In India it is grown on 3.25 million ha with the production of 2.23 million Mg and productivity of 678 kg/ha further low in the region (421kg/ha), It is having least grain to total biomass ratio among all pulse crops of India. Non availability of pigeon pea short duration and short statured improved cultivars with production technologies. While low productivity in *Alfisols* associated with low input supply and imbalanced fertilization. In the region the information on concept of target yield approach for rainfed pigeon pea was meager. Therefore study was conducted to

Objectives

- Performance evaluation of improved pigeon pea variety compared to existing variety
- To know effectiveness of fertilization through target yield approach for pigeon pea
- To assess fertilization impact on yield and quality of pigeon pea

Material and Methods

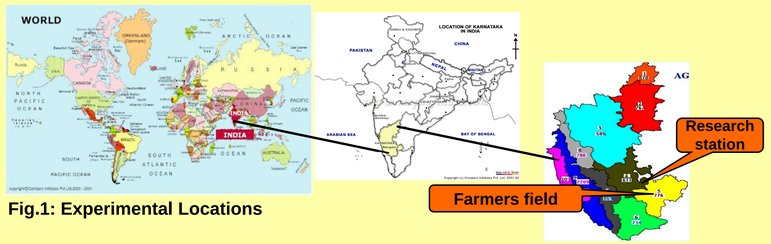


Fig.1: Experimental Locations

Locations	University of Agricultural Sciences, Bangalore, India (77^0 35' E, 12^0 58' N 930 m) and Chickaballapur, India (Farmers field) (77^0 30' E 13^0 36' N, 970 m)
Seeding Date	July 28, 2006 and August 15, 2007
Plant population	37,500/ha
Irrigation	No irrigation
Rainfall	100cm
Design	Factorial Randomized block design (Three Reps)
Treatments:	Main plots: Pigeon pea cultivars V_1: BRG-2 (Improved) V_2: TTB-7 (Existing variety) Sub plots: Nutrient levels N: 0, 25, 37.5 and 50 kg ha^{-1} P_2O_5: 0, 50, 75, 100 kg ha^{-1} K_2O: 0, 25, 50, 75 kg ha^{-1} Soil Test Crop Response (STCR) dose for a target yield (4000kg/ha)
Treatment combinations:	16 (selective combinations)
Observations	Dry matter production, seed yield, crude protein, nutrient uptake, economic returns

Crude protein yield (kg/ha) = Grain crude protein content (%) x grain yield /ha

Nutrient uptake= Nutrient concentration in grain and stalk (%) x grain and stalk yield/ha

Harvest: 2.4 m^2 length on 161 (2006) and 180 (2007) days after planting and

Fertilizer applied (kg/ha) for STCR treatment in 2006 and 2007 (at research station)

N		P_2O_5		K	
2006	2007	2006	2007	2006	2007
75.9	73.7	145.1	111.2	46	32.4

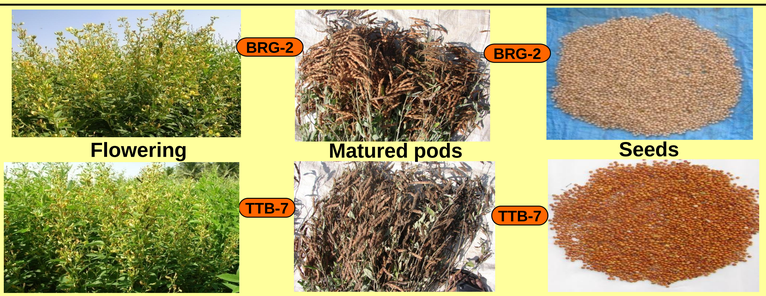


Fig. 2. Varieties of pigeon pea used in trial during 2006 and 2007 at both the locations

STCR approach equations:

Fertilizer N = 5.99 T - 227.3 OC (%)

Fertilizer P_2O_5 = 6.16 T - 2.11 SP_2O_5 (Bray's P_2O_5)

Fertilizer K_2O = 3.06 T - 0.31 SK_2O (Ammonium Acetate-K_2O)

Where,

T= Target yield

(S P_2O_5= P x 2.29 and S K_20= K x 1.2)

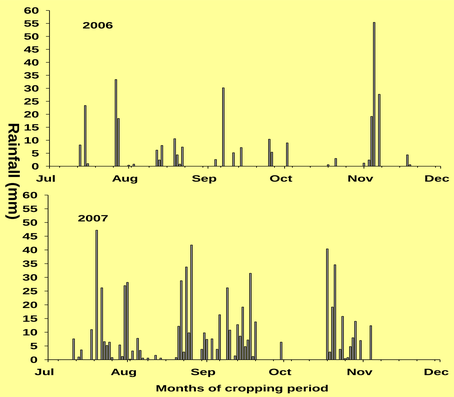
SN, SP_2O_5 and SK_2O = Initial available nitrogen, phosphorus and potassium respectively

$$\text{Fertilizer dose FN/ F } P_2O_5 \text{ /F}K_2O) = \frac{\text{NR x 100 X T}}{\text{\% CF}} - \frac{\text{\% CS}}{\text{\% CF}} \text{ X Soil test value}$$

$$\text{NR} = \frac{\text{Total nutrient uptake (kg/ha)}}{\text{Grain yield (q/ha)}} \qquad \text{CS} = \frac{\text{Total nutrient uptake unfertilized plot (kg/ha)}}{\text{Soil test value in control}}$$

$$\text{CF} = \frac{\text{Total nutrient uptake in treated plot - soil test values X CS}}{\text{Fertilizer dose}}$$

NR= nutrient requirement CS= contribution from soil CF= contribution from fertilizers



Rainfall amount and distribution was an important factor to achieve higher pigeon pea yield under higher fertilization levels. Among two years, 2007 at research station recorded higher yield and nutrient uptake compared to 2006.

Fig. 3: Rainfall distribution during cropping period at experimental site at research station (2006 and 2007)

Difference in visual appearance of treatments in 2007 at research station

Results

Table 1: Fertilization levels on yield, nutrient uptake of pigeon pea in comparison to target yield at research station (data is pooled over two years and two locations)

Treatment	Yield (kg/ha)		Nutrient uptake (kg/ha)		
	Seed	Stalk	N	P	K
$N_{25}P_{75}K_{50}SZn$	1104^c	4175^c	81^d	5^d	22^c
$N_{50}P_{75}K_{50}SZn$	1487^b	5306^b	126^b	8^c	33^b
$N_{37.5}P_{100}K_{50}SZn$	1446^b	5517^b	120^c	6^c	30^b
$N_{50}P_{100}K_{75}SZn$	1759^a	6004^a	144^a	9^b	38^a
$N_{25}P_{50}K_{25}$	940^c	3689^c	65^d	4^d	17^d
STCR	1871^a	6620^a	135^b	9^b	36^a
Varieties					
BRG-2	1391^a	4684^b	100	6.4	27.3
TTB-7	1254^b	5264^a	104	6.0	25.7

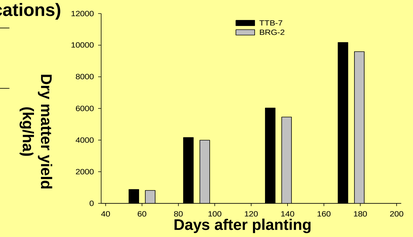


Fig. 4: Dry matter yield (kg/ha) of pigeon pea under different fertility levels

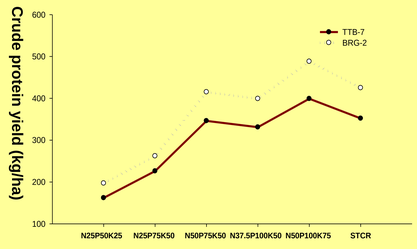


Fig. 5: Crude protein yield (kg/ha) of pigeon pea with different fertilization levels

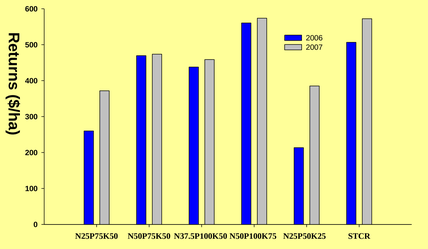


Fig. 6: Economic returns ($/ha) of pigeon pea with different fertilization levels

- **Results of two years study reveals that seed and stalk yield differed significantly with fertilization levels. Targeted yield based fertilization was helpful in achieving higher yield, nutrient uptake over state recommendations. Grain quality parameters like crude protein, NPK content differed with fertilization levels.**
- **Improved variety of pigeonpea BRG-2 out yielded TTB-7 (11%), but dry matter production was higher in TTB-7**
- **Crude protein and NPK concentration (%) was comparatively higher in BRG-2 over TTB-7**
- **Economic returns ($/ha) was more with 200 per cent recommended dose and STCR approach inspite of higher initial fertilizer input cost. However, in subsequent years input cost for target yield approach may go down.**

Summary

- **Performance of rainfed pigeonpea under higher fertility levels depends on rainfall amount and distribution .**
- **Pigeonpea variety BRG-2 was superior with respect to yield, nutrient concentrations, and grain quality under higher fertilization levels.**
- **Targeted yield based fertilization enhances yield potential, nutrient uptake and grain quality over the regional fertilizer recommendations.**

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