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Economics of pigeonpea as influenced by method of planting and integrated nutrient management in pigeonpea

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Abstract
An experiment was carried out during kharif season of 2016 at Kasbe camp District: Raichur (Karnataka) at three location under the project of ‘Bhoo Samruddhi’ ICRISAT (International Crop Research Institute for Semi-Arid Tropics Agriculture), Hyderabad, for “Evaluation of soil physico-chemical properties, growth and yield of pigeonpea as influenced by method of planting and integrated nutrient management in *Vertisols* of Karnataka”. Economic viability of pigeonpea proved superior with application of vermicompost @ 5 t ha^{-1} along with RDF (20:50 of N and P_2O_5 kg ha^{-1}), gypsum (100 kg ha^{-1}), micro nutrient (ZnSO4 @ 25 kg ha^{-1}& Borax @ 10 kg ha^{-1}) and *Rhizobium* (as seed treatment), than all other nutrient combinations. Control (farmer’s practice, with only RDF *i.e.* 20:50 of N and P_2O_5 kg ha^{-1}) registered the lowest value for economics compared to all nutrient combinations. Transplanted pigeonpea crop was superior over dibbled crop in case of method of planting. In transplanted pigeonpea crop the net returns and B:C ratio was maximum over dibbled crop.

Keywords: Transplanted, Dibbled, Nutrient, Pigeonpea

1. Introduction
Pulses, together with cereals, have been fundamental to the development of modern agriculture. They are important source of protein also rich in iron, iodine and essential amino acids. Deep rooting characteristics, ability to fix atmospheric nitrogen and huge leaf fall makes pulses an important component in cropping systems. Among pulses, pigeonpea [*Cajanus cajana* (L.) Millsp.] is the most important rainy season crop in India. It is traditionally cultivated as annual crop in Asia, Africa, Caribbean region and Latin America. This crop is grown for multipurpose uses as a source of food, feed, fuel and fertilizer. Pigeonpea is nutritionally high in protein (19 - 22%) crop with high digestible protein (68%), low in fat and sodium with no cholesterol and has high dietary fiber, vitamins (thiamine, riboflavin, niacin and choline) and minerals (iron, iodine, calcium, phosphorous, Sulphur, and potassium). Besides its main use as *dhal* (de-hulled split peas), its immature green seeds and pods re also consumed as vegetable. The dry stems of pigeonpea are used as fuel wood. Being the pulse it enriches the soil through symbiotic nitrogen fixation; release soil bound phosphorous, recycles the soil nutrients and adds organic matter and other nutrients that make pigeonpea ideal crop for sustainable agriculture (Saxena, 2008) [10].

In India from last 35 to 40 years, steps were initiated towards the ‘Green revolution’ technology which is known as ‘Exploit Agriculture’ characterized by the use of high yielding varieties, chemical and biofertilizers and pesticides, ultimately resulted in self-sufficient in food grains. ‘Green revolution’ has resulted in deterioration of soil health which ultimately resulted in lower response to applied fertilizers. This declining is largely by the imbalanced fertilizer use and rare use of secondary and micronutrients and also due to continuous use of inorganics fertilizers with minimum or no organic manures, the cultivable lands are depleted in organic C content and becoming unfertile and exerting multiple nutrient deficiencies (Katyal, 2000) [9].

The management of soil fertility and maintaining of soil health plays an important role in increasing the production and sustaining the productivity of crops. Sustainable farming depends upon the successful management of resources (inputs) for agriculture production and to satisfy the human need. No system of farming will be sustainable unless it does not care the health of soil, which plays a pivotal role in crop production. Sustainable production strategies often involve in application of organic inputs.

The use of organic manures is known to promote soil health and better plant nutrition. But organic manures alone cannot meet the nutrient requirement of crops since their availability is limited. One such approach is use of different integrated nutrient management systems which can save the soil, environment and farmer's limited resource. Integrating inorganic, organic and bio-fertilizers are essential in realizing the higher pigeonpea yield and reducing cost of production was reported by Reddy *et al.* (2011) [5]. The work of various research workers indicated that integrated nutrient management practice may play significant role to promote growth and productivity of pigeonpea in a sustainable basis as well as soil health.

Another constraint in pigeonpea productivity is delayed sowing due to late onset of rains. Time of sowing has a prominent influence on both vegetative and reproductive growth phases of pigeonpea, appropriate and proper time of sowing is one of the basic requirement for obtaining maximum yield and high returns of any crop. Pigeonpea suffers more when sowing is delayed (Padhi, 1995) [2]. Early sowing of pigeonpea *i.e.* in the month of May, ensures higher yield (Shankaralingappa and hedge, 1989) [6]. In order to ensure timely sowing on account of delayed onset of monsoon, the transplanting of pigeonpea seedlings will be one of the best alternative measures to overcome delayed sowing.

Material Method

A field experiment (in farmer's field) at three location in the same village was laid out in factorial randomized block design (FRBD) with three replications (each replication in individual farmer's field) comprising ten treatment combination. Treatment combination consisting of two factor *viz.,* Method of planting (M_1-dibbled pigeonpea and M_2-Transplanted pigeonpea) and integrated nutrient management (N_1-control *i.e.* farmer's practice, N_2-vermicompost @ 5 t ha^{-1}, N_3-FYM @ 5t ha^{-1}, N_4-neem cake @ 250 kg ha^{-1}, N_5-green leaf manure *i.e. Gliricidia* @ 5 t ha^{-1}. All the treatments were applied with RDF (20:50 N and P_2O_5 ha^{-1}). Whereas, gypsum @ 100 kg ha^{-1}**,** micronutrient ($ZnSO_4$ @ 25 kg ha^{-1} & Borax @ 10 kg ha^{-1} and *Rhizobium* (as seed treatment) was applied to all nutrient combinations except the N_1-control (farmer's practice). Pigeonpea hybrid ICPH 2740 was used as the test crop. The experiment was conducted for "Evaluation of soil physico-chemical properties, growth and yield of pigeonpea as influenced by method of planting and integrated nutrient management in *Vertisols* of Karnataka", during *kharif* 2016 at Kasbe camp, District: Raichur (Karnataka) at three location under the project of 'Bhoo Samruddhi' ICRISAT (International Crop Research Institute for Semi-Arid Tropics Agriculture), Hyderabad.

Results and Discussion

Cost of cultivation (□ ha^{-1})

Cost of cultivation of three different locations cost was calculated. For calculating the cost of cultivation of different inputs like field preparation, nursery, planting, seed cost and other cost considered. Treatment cost of cultivation calculated according to treatment variation. Cost of cultivation of dibbled and transplanted was □31478 and □34378 respectively. The cost of cultivation of (N_1-control *i.e.* farmer's practice, N_2-FYM @ 5t ha^{-1}, N_3-vermicompost @ 5 t ha^{-1}, N_4-neem cake @ 250 kg ha^{-1} and N_5-green leaf manure *i.e. Gliricidia* @ 5 t ha^{-1} was □28188, □33363, □36863, □32863 and □33363 respectively. The maximum cost was incurred in N_3 and minimum cost in N_1 (farmer's practice).

Gross returns (□ ha^{-1})

For the calculation of gross returns, market rate of pigeonpea grains and stalk was considered at □55 kg^{-1} and 1.5 kg^{-1} respectively according to local market of the location. The gross monetary return was significantly higher due to transplanted pigeonpea □139371 and minimum in the case of dibbled □110514. With respect to nutrient combinations, the gross returns was significantly higher with application of N_3-vermicompost @ 5 t ha^{-1} □149215 than all other nutrient combinations treatment. Sharma *et al.* (2010) [8] found similar results with application of vermicompost @ 2.5 t ha^{-1}. And treatments N_2-FYM @ 5t ha^{-1}, N_4-neem cake @ 250 kg ha^{-1} and N_5-green leaf manure *i.e. Gliricidia* @ 5 t ha^{-1} was recorded higher gross returns (□129724, □122319 and □126531 respectively) than N_1 control *i.e.* Farmer's practice (□96926), Sharma *et al.* (2012) [7] reported similar results with application of FYM @ 5t ha^{-1}. The lowest gross return was observed in the case of farmer's practice than compared to all other treatments.

Net returns (□ ha^{-1})

The net returns was maximum in case of transplanted pigeonpea and minimum in case of dibbled (□104993 and □79036 respectively). Transplanted method of cultivation of pigeonpea gives □25957 advantage over dibbled in respect to monitory net returns. Mallikarjun (2012) [1] reported similar results with transplanting hybrid pigeonpea than dibbled hybrid. The net return in integrated nutrient management was significantly higher in the case of N_3-vermicompost @ 5 t ha^{-1} (□112352) than N_1-control *i.e.* Farmer's practice (□68738). N_2-FYM @ 5 t ha^{-1} (□96361), N_4-neem cake @ 250 kg ha^{-1} (□89456) and N_5-green leaf manure *i.e. Gliricidia* @ 5 t ha^{-1}(□93168). Lowest net returns was observed in the case of farmer's practice compared to all other treatments about □68738 only. Pandit *et al.* (2015) [4] reported similar results, with addition of FYM at 5 t ha^{-1} with significantly higher net return (INR 31924 ha^{-1}) and B: C ratio (2.16) over that in control (INR 29472 ha^{-1} and 1.95, respectively).

B:C ratio

The B:C ratio was maximum in case of transplanted pigeonpea and minimum in case of dibbled (4.04 and 3.50 respectively). Difference between both the methods of planting was very vast in respect to benefit cost ratio, so by the adaptation of transplanting technology in pigeonpea, the farmers can take monitory advantage over dibbling method of planting. The B:C ratio in integrated nutrient management was higher in the case of N_3-vermicompost @ 5 t ha^{-1} (4.04) than N_1-control *i.e.* Farmer's practice (3.43). N_2-FYM @ 5 t ha^{-1} (3.88), N_4-neem cake @ 250 kg ha^{-1} (3.71) and N_5-green leaf manure *i.e. Gliricidia* @ 5 t ha^{-1}(3.78). Lowest B:C ratio was observed in the case of farmer's practice compared to all other treatments, about 3.43 only. Pandit *et al*. (2015) [4], Pandey *et al.* (2015) [3], reported similar results with application of FYM 5.0 t ha^{-1} over control.

Table 1: Economics of pigeonpea as influenced by method of planting and integrated nutrient management

	Cost of cultivation	**Gross returns**	**Net returns**	**B:C Ratio**
Treatments	**(□ ha^{-1})**	**(□ ha^{-1})**	**(□ ha^{-1})**	
Method of establishment (M)				
M1 : Dibbled	31478	110514	79036	3.50
M2 : Transplanted	34378	139371	104993	4.04
Mean	---	124943	92015	3.77
SEm±	---	2513	2513	0.08
C.D at 5%	---	7467	7467	0.23
Nutrient (N)				
N1 : Control	28188	96926	68738	3.43
N2 : FYM	33363	129724	96361	3.88
N3 : Vermicompost	36863	149215	112352	4.04
N4 : Neem cake	32863	122319	89456	3.71
N5 : Green leaf manure	33363	126531	93168	3.78
Mean	---	124943	92015	3.77
SEm±	---	3974	3974	0.12
C.D at 5%	---	11807	11807	0.36
Interaction				
(M X N)	---	NS	NS	NS

NS: Non-significant, DAP: Days after planting, RDF: 25:50 kg ha^{-1} of N and P_2O_5. Control: RDF only (farmer's practice), FYM @ 5 t ha^{-1}, Vermicompost @ 5 t ha^{-1}, Neem cake @ 0.25t ha^{-1}, Green leaf manure (*Gliricidia*) @ 5 t ha^{-1}. All the treatments except control was applied with micronutrients ($ZnSO_4$ @ 25 kg ha^{-1} and Borax @ 5kg ha^{-1}), biofertilizer: (*Rhizobium* as seed treatment) and gypsum @100 kg ha^{-1}).

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