Environment & Ecology 35 (2B) : 1131—1135, April—June 2017
Website: environmentandecology.com ISSN 0970-0420

Economic Analysis of Mungbean Cultivation in Allay Space of Custard Apple Influenced by Different Levels of Organic-Nutrients, Bio-Fertilizers and PGR's

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Received 12 July 2016; Accepted 16 August 2016; Published online 1 September 2016

Abstract A field experiment was conducted in a sandy loam soil during *kharif* season, 2012-2013 to find out the economics of mungbean cultivation in allay space of custard apple influenced by different levels of organic-nutrients, bio-fertilizers and PGR's. This region comes under agro-climatic zone IIIA (semi-arid Eastern plain zone). The experiment was conducted in a complete randomized block design with different treatments combination viz. Harit vardan (bio-fertilizer), Bioplantomin (liquid bio-manure), Biovita (organic product), Farm bahar (polymorphic growth hormones) and Plantgro (multi-micronutrients) which were replicated thrice. These treatments were applied in different doses and method of application of these treatments either in the form of soil treatment or foliar spray. The economic attributes viz. gross and net return were found highest in (T_6) Bioplantomin (liquid bio-manure) was applied at 3.5 l ha^{-1} as foliar spray while B:C ratio was obtained higher in Biovita 0.8 l ha^{-1} (T_9) and lowest B:C ratio, gross and net return obtained with control treatments (T_{13}).

Keywords Agri-horti system, Custard apple, Net return, B:C ratio, Mungbean.

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Introduction

Pulses in India have long been considered as the poor man's only source of protein. India is the world's largest grower of pulse crops (food legumes) covering about 23.0 million hectares and producing about 14.8 million tons [1]. But due to shrinking land resources along with burgeoning population it is very difficult maintain availability of pulses for the population. Under current situation introduction of pulses as an intercrop in the alleys of agri-horticultural plantation not only provides extra income but also improves soil fertility, enabling the main crop to give a better yield [2]. Among pulses, mungbean being ecologically ver-

Table 1. Treatment details.

Code	Treatments	Quantity	Application
T_1	Harti vardan (Bio-fertilizer)	3.5 kg ha^{-1}	Soil treatment
T_2	Harti vardan (Bio-fertilizer)	5.5 kg ha^{-1}	Soil treatment
T_3	Harti vardan (Bio-fertilizer	7.5 kg ha^{-1}	Soil treatment
T_4	Bioplantomin (Liquid bio-manure)	1.5 l ha^{-1}	Foliar spray
T_5	Bioplantomin (Liquid bio-manure)	2.5 l ha^{-1}	Foliar spray
T_6	Bioplantomin (Liquid bio-manure)	3.5 l ha^{-1}	Foliar spray
T_7	Biovita (Organic product)	0.4 l ha^{-1}	Foliar spray
T_8	Biovita (Organic product)	0.6 l ha^{-1}	Foliar spray
T_9	Biovita (Organic product)	0.8 l ha^{-1}	Foliar spray
T_{10}	Farm bahar (Polymorphic growth hormones)	2.0 ml l^{-1}	Seed treatment
T_{11}	Farm Bahar (Polymorphic growth hormones)	2.0 ml l^{-1}	Seed treatment + Foliar spray
T_{12}	Plantgro (Multi-micronutrients)	4.0 g l^{-1}	Foliar spray
T_{13}	Control	–	–

Table 2. Common cost of cultivation (Rs ha^{-1}).

Sl. No.	Operation	Input	Rate (Rs)	Cost (Rs)
1	Land preparation			
	(i) One deep ploughing by soil turning plough	One tractor (35 HP) for 2.5 hrs	300 Rs ha^{-1}	750
	(ii) Harrowing and planking	One tractor (35 HP) for 4 hrs	300 Rs ha^{-1}	1200
2	Layout	4 labor day^{-1}	125	500
3	Seed sowing	8 labor day^{-1}	125	1000
4	Seed (HUM-16)	15 kg ha^{-1}	120	1800
5	Fertilizer			
	Urea (20 kg ha^{-1})	166.37 kg	7.00	1164.59
	DAP (60 kg ha^{-1})	130.43 kg	13.00	1695.59
	MOP (40 kg ha^{-1})	66.67 kg	6.00	400.02
6	Thinning and weeding	10 labor day^{-1}	125	1250
7	Weeding (Custard apple)	6 labor day^{-1}	125	750
8	Harvesting and threshing	25 labor day^{-1}	125	3125
9	Harvesting fruit (Custard apple)	20 labor day^{-1}	125	2500
10	Land revenue	For 6 months	130 Rs/Annum	65
11	Interest on working capital	For 6 months	14%/Annum	891.45
12	Others			973.21
			Total	18064.86

satile is widely cultivated in various climate and geographical regions of India [3] and was found be one of the most suitable intercrop in the alleys of agri-horti system.

Custard apple (*Annona squamosa* L.) is distributed throughout the tropics and is pre-eminently a desert fruit, normally eaten fresh. The vitamin C content is appreciable (35–42 mg 100^{-1} g) and slightly higher than the grape fruit. The tree is a good source of firewood, the light yellow sapwood and brownish heartwood are soft, light in weight and weak. Green fruits, seeds and leaves have effective vermicidal and insecticidal properties.

Mungbean (*Vigna radiata* L. Wilczek) is a pulse or food legume crop which can play the major role in national economy of India due to their wider adaptability, easy digestibility, better palatability and higher market price [4—6]. Potential yield of mungbean can be achieved through optimum use of inputs and agronomic practices. It is drought tolerant that can withstand adverse environmental conditions and hence successfully be grown in rain fed areas [7]. It is widely grown in Indian subcontinent as a short duration catch crop between two principal crops [8]. Mungbean, compared with other crops has a better chance of surviving under adverse condition such as poor soil fertility and moisture stress.

Organic-nutrients, bio-fertilizers and plant growth regulators (PGR's) are known to improve physiological efficiency including photosynthetic ability of plants and offer a significant role in realizing higher crop yields which in turn higher income. Fertilizer is one of the most important factors that affect crop production. Fertilizer recommendation for soils and crops is a dynamic process [9—11] and the manage-

Table 3. Profitability analysis.

Treatments	Fixed cost (Rs ha^{-1})	Variable cost (Rs ha^{-1})	Cost of cultivation (Rs ha^{-1})	Gross return (Rs ha^{-1}) Seed yield	Stover yield	Fruit yield	Total	Net return (Rs ha^{-1})	B:C ratio
T_1 Harit vardan 3.5 kg ha^{-1}	18064.86	7775	25839.86	41251.7	8088.4	18125.00	67465.1	41625.24	1.61
T_2 Harit vardan 5.5 kg ha^{-1}	18064.86	12075	30139.86	43738.1	8213.88	18125.00	70076.98	39937.12	1.32
T_3 Harit vardan 7.5 kg ha^{-1}	18064.86	16375	34439.86	50001	8494.72	18125.00	76620.72	42180.86	1.22
T_4 Bioplantomin 1.5 l ha^{-1}	18064.86	3675	21739.86	56679	8777.04	18125.00	83581.04	61841.18	2.84
T_5 Bioplantomin 2.5 l ha^{-1}	18064.86	5625	23689.86	69120.1	10047.72	18125.00	97292.82	73602.96	3.10
T_6 Bioplantomin 3.5 l ha^{-1}	18064.86	7575	25639.86	72433.2	10288	18125.00	100846.2	75206.34	2.93
T_7 Biovita 0.4 l ha^{-1}	18064.86	1018	19082.86	42088.9	8115.72	18125.00	68329.62	49246.76	2.58
T_8 Biovita 0.6 l ha^{-1}	18064.86	1152	19216.86	46848.9	8379.32	18125.00	73353.22	54136.36	2.81
T_9 Biovita 0.8 l ha^{-1}	18064.86	1286	19350.86	58594.2	8974.48	18125.00	85693.68	66342.82	3.42
T_{10} Farm bahar 2 ml l^{-1}	18064.86	3000	21064.86	60984.7	9014.96	18125.00	88124.66	67059.8	3.18
T_{11} Farm bahar 2 ml l^{-1}	18064.86	6000	24064.86	66999.1	9844.24	18125.00	94968.34	70903.48	2.94
T_{12} Plantagro 4 g l^{-1}	18064.86	6500	24564.86	71022.7	10203.44	18125.00	99351.14	74786.28	3.00
T_{12} Control plot (untreated)	18064.86	000.00	18064.86	40644.1	7947.12	18125.00	66716.22	48651.36	2.69

ment of fertilizers is one of the important factors that greatly affect the growth, development and yield of mungbean [12]. By incresing the yield of mungbean farmers can get higher gross and net returns. Organic nutrients also provide balanced nutrition in addition to enhancing water holding capacity and improving physical, chemical and biological properties (micro-organisms) of soils which assist in better uptake of nutrients. Multi-micronutrients are important supplement for the plant food. It is feasible in open field agriculture and also contain iron and zinc that are often immobilized in the conducting system, enter into the plant system through leaves. Besides, PGR'S also enhance protein and nutrient content (nitrogen, phosphorus and potassium) of food grain and ultimately influences the growers income.

Sustainability of any crop cultivation is mainly depends on its economic aspect but limited study was done on mungbean in this regard. In view of the discussion, hence, there is a need to study the economic analysis of mungbean cultivation in allay space of custard apple influenced by different levels of organic-nutrients, bio-fertilizers and PGR's.

Materials and Methods

The experiment was carried out in the year 2011–2012, at the Agronomy farm of Rajiv Gandhi South Campus, Brakachha (BHU) Mirzapur which is situated in Vindhyan region of district Mirzapur (25° 10´ latitude, 82° 37´ longitude and altitude of 427 meters above mean sea level occupying over an area of more than 1000 ha where variety of crops like agricultural, horticultural, medicinal and aromatic plants are grown. Vindhyan soil comes under rainfed and invariably poor fertility status. This region comes under agro-climatic zone IIIA (semi-arid eastern plain zone). Maximum temperature in summer is as high as 44.65°C and minimum temperature in winter falls below 8.12°C. The average annual rainfall of locality is 1100 mm, of which neatly 90% is contributed by south west monsoon between July to September. The total rainfall during the crop season 2012-13 was 1207.4 mm, maximum and minimum temperature are 38.7°C and 16°C and relative humidity are 90 and 33% respectively. The experiment was conducted in randomized block design with 13 treatments which were replicated thrice (Table 1).

Recommended intercultural operations were practiced. The biometric observations on growth attributes were recorded at an interval of 15 days, that is 15, 30th and 45th days after sowing and at maturity. For protein content, seed sample from each plot was taken randomly and subjected to chemical analysis by Kjeldahl's method. Available nitrogen percentage was determined through standard wet digestion method. Nitrogen percentage was converted to protein content by multiplying with constant factor (6.25). The

Table 4. Growth parameters of custard apple.

Tree height (m)		Canopy diameter (m)		Stem girth (cm)		Shading (m)	
At sowing	At crop maturity	At sowing	At crop maturity	At sowing	At crop maturity	At sowing	At crop maturity
2.88	3.62	8.10	8.73	32.78	33.54	2.88	4.72

cost of cultivation was worked out by taking into consideration all the expenses incurred. Gross income was worked out by multiplying grain and straw yield of the crop with their prevailing market prices. Calculations were made as per normal rates prevalent at the research Farm, RGSC (BHU), Barkachha, Mirzapur. The cost of fertilizers, manure, and seed were taken as per prevailing market prices. Net return (Rs ha^{-1}) and benefit:cost ratio were calculated with the help of the following formula.

Net return (Rs ha^{-1})=Gross return (Rs ha^{-1}) – Cost of cultivation (Rs ha^{-1})

$$\text{Benefit : Cost ratio} = \frac{\text{Net return}}{\text{Cost of cultivation}}$$

Results and Discussion

Cost of mungbean production influenced by different levels of Organic-nutrients, bio-fertilizers and PGR's

Cost are the expenses in organizing and carrying out the production process. The cost of production included different variable cost items like land preparation, human labor, seed, manure, fertilizers. Cash expenditure was included in the analysis and are shown in Table 2. It revealed that highest cost was incurred for human labor (Rs 11075) followed by fertilizers and manures (Rs 3260.20) and seed cost (Rs 1800) when interest on working capital for 6 months (Rs 891.45). The average cost of production in full cost basis was found to be 18064.86 Rs ha^{-1} which was found slightly higher due to more cost involvement in human labor.

Profitability of mungbean cultivation due to influence of different levels of Organic-nutrients, bio-fertilizers and PGR's

The data pertaining to the economics as influenced by different levels of Organic-nutrients, bio-fertilizers and PGR's on economics are presented (Table 3). The data indicated that the net return (Rs 75206.34) and gross return (Rs 100846.20) recorded higher in Bioplantomin 3.5 l ha^{-1} (T_6) with B:C ratio (2:93) which was low due to high variable cost but the B:C ratio was obtained higher (3.42) in Biovita 0.8 l ha^{-1} (T_9) followed by Farm bahar 2 ml l^{-1} (T_{10}) (3.18), Bioplantomin 2.5 l ha^{-1} (T_5) (3.10) and Plantgro 4 g l^{-1} (T_{12}) with B:C ratio (3.0) under custard apple based agri-hortisystem, due to low variable cost and maximum net return. These results are in conformity with the findings [13, 14].

Growth parameters on custard apple

Statistically non significant differences observed in the mentioned growth parameters of custard apple might be due to shorter growth phase of mungbean which could not realized the noticeable changes in the limited observation period (Table 4).

Conclusion

Among the various treatments applied in the experiment, the Bioplantomin 3.5 l ha^{-1} (T_6) recorded the highest net (Rs 75206.34) and gross return (Rs 100846.20) with low B:C ratio (2:93) due to high variable cost but the B:C ratio was obtained higher (3.42) in Biovita 0.8 l ha^{-1} (T_9) due to low variable cost and maximum net return. Based on above results, it may be concluded that Bioplantomin 3.5 l ha^{-1} should be applied through foliar spray to obtained maximum net and gross return and for higher B:C ratio (3.42), Biovita 0.8 l ha^{-1} (T_9) should be applied through foliar spray in mung bean under custard-apple based agri-horticulture system.

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