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EVALUATION OF DIFFERENT NUTRIENT LEVELS AND IRRIGATION ON ECONOMIC FEASIBILITY FOR BHINDI (*Abelmoschus esculentus* (L) MOENCH) AS MAIN CROP AND AMARANTHUS (*Amaranthus bicolor*) AS RESIDUE CROP

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Abstract

An experiment was conducted at College of Agriculture, Vellayani to standardize the organic manuring schedule for bhindi and to assess the effect of different levels of organic manure combination and irrigation on economic feasibility of bhindi as main crop and amaranthus as residue crop from June 2009 to November 2009. The organic nutrient combination (17 t ha^{-1} FYM + 2.83 t ha^{-1} vermicompost + 1.47 t ha^{-1} glyricidia leaves) gave the maximum total fruit yield (10.58 t ha^{-1}). When amaranthus was raised after bhindi as a residue crop, the plots with the same dose of nutrient combination also recorded the maximum fresh yield of amaranthus (18.92 t ha^{-1}) when harvested at 45 DAS. Along with mulching, the same nutrient dose of 17 t ha^{-1} FYM + 2.83 t ha^{-1} vermicompost + 1.47 t ha^{-1} glyricidia leaves resulted in highest B:C ratio for bhindi as well as for bhindi – amaranthus sequence.

KEY WORDS: vermicompost, glyricidia leaves, yield, B:C ratio

I. INTRODUCTION

India is the second largest producer of vegetables, second only to China with a production of 162.18 million ta from an area of 9.4 million ha (NHB, 2015). However, to satisfy, the national and international demand, India has to go a long way to accelerate the vegetable production. There is a need to achieve the target of 225 million tonnes by the end of 2020 and 350 million tonnes by 2030 (IIVR, 2011). The production technologies should be designed in such a way that the production and productivity should be increased without compromising the quality of the environment and soil as well as the produce. As vegetables are consumed even in raw form, pesticide residue problems are likely to result in very worse health problems. Immune-suppression, hormone disruption, diminished intelligence, reproductive abnormalities, cancer etc. are some of the health hazards caused by pesticide residues in vegetables.

The presence of pesticide residues in vegetables is of great concern these days. Moreover, unscientific use of fertilizers has also resulted in pollution of air and water. As the demand for organic vegetables is increasing day by day, the effect of using different organic manures for the production of vegetables have been studied by several workers.

Among the wide variety of vegetables being cultivated in India, bhindi (*Abelmoschus esculentus* L. Moench.) is a popular one. Besides containing no saturated fats or cholesterol, they are rich sources of dietary fibre, minerals, and vitamins; often recommended by nutritionists in cholesterol controlling and weight reduction programmes.

The present study is to assess the effect of using organic nutrient sources, mulching and irrigation on the yield to work out the economics of bhindi and bhindi - amaranthus crop sequence.

II. MATERIALS AND METHODS

The experiment was laid out in factorial randomized block design with factor A consisting of four levels of nitrogen (50 % of which is applied as FYM, 25 % as vermicompost and 25 % as glyricidia leaves) *viz.* N_1 – 100 % of recommended dose of nitrogen, N_2 - 75 % of recommended dose

of nitrogen, N_3 - 50 % recommended dose of nitrogen and N_4– 12 t FYM + 110:35:70 kg N: P: K ha^{-1} – (Recommended dose of fertilizer as control) and factor B with two types of irrigation *viz*., I_1- Rain fed with green leaf mulching and I_2 - Need based irrigation (irrigation at 50 % depletion of available soil moisture). All the organic manure combinations were applied as basal while the inorganic fertilizer was applied as basal (Half N, full P and K) and half N as top dressing at 30 days after sowing. Seeds were treated with *Azospirillum* before sowing. Vermiwash and cow's urine (each at 10 times dilution were applied as foliar spray at fortnightly interval. Need based application of *Pseudomonas fluorescens* (2 % solution) for disease management and application of neem oil garlic extract (2 %) for pest management were done as per requirement. To assess the residual effect of different treatments, a crop of amaranthus was raised after bhindi and the yield obtained was recorded.

III. RESULTS AND DISCUSSION

The total fruit yield was significantly influenced by different nutrient levels (table 1). The highest total fruit yield ha^{-1} was recorded by the treatment (N_1) in which 100 % nitrogen was applied as organic (10.58 t ha^{-1}) which was on par with RDF (9.82 t ha^{-1}). The lowest fruit yield was recorded by N_3 (8.54 t ha^{-1}) and was on par with N_2 (8.39t ha^{-1}). The positive direct effect of growth and yield attributing characters due to increased dose of organic manure have resulted in significantly higher fruit yield ha^{-1}. Similar results of increased fruit yield $plant^{-1}$ due to increased nutrient levels have been reported by Raj (1999). Even though not significant, rain fed mulched plots produced a total fruit yield of 9.71 t ha^{-1} compared to 8.94 t ha^{-1} from the irrigated unmulched plots. Sheela *et al*. (2007) also observed yield increase in bhindi due to mulching.

The different nutrient levels could significantly influence the yield of subsequent crop-amaranthus (Table 1). The highest yield was recorded by the highest dose of nutrient (N_1) which was significantly superior to all other treatments. This could be attributed to the increased availability of nutrients from organic manures for a longer time resulting in higher yield of residue crop. In contrast to the chemical fertilizers, the availability of nutrients present in the bulky organic manures such as FYM is quite slow during the current season. In case of FYM, reports reveal that only half nitrogen, one sixth phosphorus and a little greater than half of potassium alone are readily available to plant during the first season of application (Thampan, 1993). Their availability is spread over more than one season.

Thus, raising a residue crop after the first season would help in better utilization of available nutrients. Amaranthus was sowed after the harvest of bhindi in the respective plots. Amaranthus yield in rain fed mulched plots was significantly higher due to the extended influence of conserved nutrients due to mulching and the nutrient release during the course of decomposition of mulch material. Similar results of increase in yield of residue crop due to mulching were reported by Sharma *et al*. (2009).

The highest B:C ratio was recorded by the highest dose of organic manure (100 % N equivalent -17 t ha^{-1} FYM + 2.83 t ha^{-1} vermicompost + 1.47 t ha^{-1} glyricidia leaves) both in the case of bhindi as well as for the bhindi –amaranthus sequence.

The different levels of nutrients and irrigation had significant influence on the B:C ratio of bhindi as well as the cumulative B:C ratio of bhindi – amaranthus sequence. While considering the high market price for organic produce, the plots which received highest level of organic manuring (100 % of N equivalent) recorded maximum B:C ratio of 2.03 for bhindi and 3.88 for the sequence. For bhindi, highest level of organic manuring (100 % of N equivalent) registered 17.25 % more returns than that of RDF. Organic nutrient levels at 75 % and 50 % of N equivalent recorded increased returns of about 11.91 % and 14.96 % respectively compared to the RDF. For the sequence, highest level of organic manuring (100 % of N equivalent) registered 36.6 % more returns than that of RDF. Organic nutrient levels at 75 % and 50 % of N equivalent recorded increased returns of about 20.39 % and 13.84 % respectively compared to the RDF. The high yield produced by the highest level of organic nutrition resulted in higher B:C ratio for these plots. The high price fetched by the organic

bhindi along with high yield compared to the RDF resulted in highest B:C ratio. A similar result of increased profit was reported by Raj (1999) in bhindi with organic nutrition.

For both bhindi and bhindi- amaranthus sequence, higher B:C ratio was recorded for mulched rainfed plots. Considering the high market price for organic produce mulched rainfed plot recorded 23.72 % more B:C ratio compared to that of irrigated plots in bhindi and 45.6 % for the sequence. The higher B:C ratio for rainfed mulched plots may be due to the reduced cost of cultivation for these plots considering the cost incurred for irrigation for irrigated plots.

Table1. Effect of different nutrient levels and irrigation on the yield and B: C ratio of bhindi and bhindi + amaranthus sequence

Treatments	Total fruit yield of bhindi (t ha^{-1})	Yield of amaranthus (t ha^{-1})	B:C ratio for Bhindi	B:C ratio for Bhindi + Amaranthus (sequence)
Nutrient levels				
N_1	10.58	18.92	2.03	3.88
N_2	8.54	13.61	1.68	3.09
N_3	8.39	10.48	1.73	2.84
N_4	9.82	14.10	1.48	2.46
F(3,14)	7.081**	16.890**	20.790*	32.000*
SE(N)	0.395	0.852	0.050	0.106
CD	1.198	2.584	0.150	0.323
Irrigation				
I_1	9.72	19.91	2.01	3.97
I_2	8.95	9.09	1.44	2.16
F(1,14)	3.805 ^{NS}	161.432**	132.564**	287.826**
SE(I)	0.280	0.602	0.053	0.075
CD	-	1.827	0.106	0.228
Interaction				
N_1I_1	11.52	25.23	2.42	5.07
N_1I_2	9.65	12.61	1.64	2.69
N_2I_1	8.56	19.19	1.87	3.97
N_2I_2	8.53	8.03	1.49	2.20
N_3I_1	8.88	14.65	2.02	3.69
N_3I_2	7.90	6.30	1.43	1.99
N_4I_1	9.92	20.58	1.74	3.14
N_4I_2	258.46	9.41	1.22	1.77
F(7,14)	1.129 ^{NS}	1.098 ^{NS}	2.793*	3.882*
SE(N x I)	0.559	1.205	0.070	0.150
CD	-	0.212	0.212	0.456

**- Significant at 1% level, *- Significant at 5% level, NS - Not Significant

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