

Evaluating Performance of Root Vegetables and Spices in Association with Banana (*Musa Spp.*) Under Coastal Plain Zone of Odisha

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ABSTRACT

The present investigation was undertaken to evaluate the performance of different root vegetables and spices as intercrops along with banana in terms of production potential and selling price under coastal plain zone of Odisha. The experiment was carried out during 2013 and 2014 at All India coordinated Research Project on Fruits in Horticulture Research Station, Bhubaneswar, Odisha. Results revealed that banana as a sole crop gave a yield of 29.63 t/ha. Whereas arrow root intercropped with banana gave the highest yield of 16.4 t/ha and banana 28.88t/ha and followed by elephant foot yam 13.5 t/ha and banana 29.75t/ha but the minimum yield was with ginger where a yield of 6.2 t/ha and banana 28.56 t/ha was obtained. Banana and arrow root intercropping yielded a net profit of Rs. 3, 98,750/- as compared to a net profit of Rs. 3, 66,450/- with banana + turmeric and a net profit of Rs. 1, 95,750/- under control. Maximum B: C ratio of 2.38 was obtained in Banana + arrow root intercropping as compared to 2.29 with Banana+Turmeric and minimum under control.

Keywords: Intercropping, Root Vegetables, Spices, Banana, Production Potential

INTRODUCTION

Banana which is referred as kalpataru (plant of virtues) and kalpavriksha produce the wonder berry forming staple food for millions across the globe providing balance diet, a rich source of carbohydrates nearly free of fat having many therapeutic values and a way of livelihood of many farmers in India and Odisha is closely associated with the cultural heritage, culture and considered to be a symbol of prosperity and fertility in Indian mythology.

Sustainable agriculture seeks at least principles to use nature as the model for designing agriculture system. Since we are modelling nature understanding of the principles by which nature functions and utilisation of the principles to reduce cost and increase profitability and at the same time sustaining our ecology and land resources are quite important for modern agriculture. There is far more cooperation in nature than competition while growing intercrops. Intercropping offers farmers the opportunity to engage nature's principle of diversity on their farms. Plant spatial arrangements, planting rates, spacing, crop growth and their growth behaviour act as an insurance against failure of crops under adverse condition gives additional income, reduced soil run off, utilize resources efficiently and maintain the soil fertility and nutrient uptake from different layer of soils depending upon the root growth of different crops. Intercropping in scientific way should be viewed from a theme of competition to one of collaboration with mutually beneficial relation with proper planning to get more return from limited natural resources.

The inter spaces remain idle for the initial 4 to 5 months of crop growth and the interspaces can be very well utilized by growing some vegetable crops which do well under partial shade condition. Keeping the above facts in view, it was thought worthwhile to utilize interspaces in newly planted banana by growing some root vegetable crops like colocasia (*Colocasia esculenta*), elephant foot yam (*Amorphophallus campanulatus*), arrowroot (*Maranta arundinaceae*), ginger (*Zingiber officinale*), mango ginger (*Curcuma amada*) and turmeric (*Curcuma longa*). These intercrops are mostly partial

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shade loving ones. The present investigation was conducted to evaluate performance of root vegetables and spices in association with banana (*Musa spp.*) plantation under coastal plain zone of Odisha.

MATERIALS & METHODS

The present investigation was carried out at AICRP on Banana located at the Horticultural Research Station, OUAT during the year 2013 and 2014. Inter crops such as, Elephant Foot Yam (Var. Gajendra), Colocasia (Var. Muktakeshi), Turmeric (Var. Surama), Ginger (Var. Suprava), Mango Ginger (Var. Amba), Arrowroot (Var. khordha local) along with a sole crop of Banana (Var. Champa) as control were the treatments laid out in RBD with three replications. All cultural operations were followed as for recommended package of practices for Odisha region. Observations were recorded on growth and yield related characters of main crop of banana and intercrops. Total return from Banana + intercrops was calculated and it was deducted from the total cost of cultivation to get the net return. Benefit cost ratio was calculated by dividing net income by cost of cultivation. Data was statistically analyzed by the procedure given by [1].

Banana is planted at a spacing of 2 m apart and in the interspaces intercrops is planted. Spacing followed for banana, colocasia, elephant foot yam, arrow root, ginger, mango ginger, turmeric was 2mX2m, 75cmX75cm, 60cmX20cm, 20cmX30cm, 20cmX30cm, 20cmX30cm and 60cmX30cm respectively in all treatment combinations. The treatments are in the following crop combinations. T1- Banana + Colocasia; T2- Banana+ Elephant foot yam; T3- Banana + Arrow root; T4- Banana + Ginger; T5- Banana + Mango ginger; T6- Banana + Turmeric; T7- Control.

RESULTS & DISCUSSION

Statistical analysis was done for the yield data of all crops in cropping systems and sole cropping. The height of banana along with girth of pseudostem, number of hands, number of fingers and over all weight of the bunch in banana are more economical characters deciding net return from a plantation. It was seen from the observed data that most of the economical characters of banana did not vary significantly due to growing of intercrops. It was more or less observed that banana performed better when intercrops are grown than alone. Banana plant recorded the highest height in association with ginger and it was found to be more in other treatments as compared to control. The total yield of bunch in t/ha is presented in Table 1. It is observed that the yield of banana per hectare did not vary significantly during the trial. The highest bunch yield of 30.00 t/ha was recorded with Banana + Colocasia intercropping followed by 29.75 t/ha with Banana + Elephant Foot Yam, 29.63 t/ha in Banana + Mango ginger & control. Banana + turmeric produced 29.26 t/ha, Banana and arrow root 28.88 t/ha and the lowest with Banana + Ginger, where a yield of 28.56 t/ha was obtained. Number of leaves/plant, bunch weight and yield of banana in tonnes/ha did not vary significantly indicating that growing of shallow rooted, partially shade loving intercrops on banana did not significantly influence the growth parameters (Table 1) but, overall most of the parameters showed slightly positive influence.

Table1: Comparative Growth and Yield Characters of Banana

Treatment	Plant height (cm)	Plant girth (cm)	No. of leaves / plant	Bunch weight (kg)	Yield of bunch (t/ha)	
T1	Banana+ Colocasia	275.25	56.35	10.93	12.00	30.00
T2	Banana + Elephant foot Yam	274.13	60.68	10.38	11.90	29.75
T3	Banana+Arrowroot	280.13	62.23	10.30	11.55	28.88
T6	Banana + Ginger	283.13	57.23	10.73	11.43	28.56
T5	Banana + Mango Ginger	272.35	58.18	9.98	11.85	29.63
T6	Banana + Turmeric	274.13	65.50	9.88	11.71	29.26
T7	Control	266.18	54.05	10.50	11.85	29.63
	SEM±	5.047	2.755	0.358	0.151	0.377

[2] reported that productivity and income was enhanced in banana variety Nendran by modifying the planting pattern and adopting intercropping. Number of suckers produced per plant, days taken for

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appearance of spadix, days taken for emergence of bunch, number of hands/bunch and number of fingers per bunch are important characters in banana over all deciding the health and reproductive characteristics of banana (Table 2).

Table2: Comparative yield attributing characters of banana

Treatment		Plant height (cm)	Plant girth (cm)	No. of leaves / plant	Bunch weight (kg)	Yield of bunch (t/ha)
T1	Banana+ Colocasia	275.25	56.35	10.93	12.00	30.00
T2	Banana + Elephant foot Yam	274.13	60.68	10.38	11.90	29.75
T3	Banana+Arrowroot	280.13	62.23	10.30	11.55	28.88
T6	Banana + Ginger	283.13	57.23	10.73	11.43	28.56
T5	Banana + Mango Ginger	272.35	58.18	9.98	11.85	29.63
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T7	Control	266.18	54.05	10.50	11.85	29.63
	SEM±	5.047	2.755	0.358	0.151	0.377
	CD(0.05)	NS	NS	NS	NS	NS

Number of fingers per bunch was found significant and other characters did not vary much in banana due to the effect of intercrops. The number of fingers per bunch in different treatments during the trial is presented in the table 2 which varied significantly among the treatments. Highest (155.38) number of fingers per bunch was recorded in control followed by 153.80 with Banana + Arrowroot, 149.20 with Banana + Turmeric, 144.8 in Banana + Colocasia, 143.50 with Banana + Mango ginger, 129.35 with Banana + Ginger and 138.25 with Banana + Elephant Foot Yam, and 155.38 in Control respectively. Number of suckers per plant, days taken for appearance of spadix, days taken for emergence of bunch, days taken for maturity of bunch and number of hands per bunch which has already been reported by [3] who confirmed that there was no perceptible deleterious effect on growth and productivity of banana due to intercropping with different genotypes of Dioscorea. Intercropping banana with SreeKeerthi and SreePriya was very profitable in comparison to farmer’s practice of sole cropping of banana. The present finding is in conformity with the findings of [4] and [5]. Most of the growth characters of intercrops varied significantly for height of intercrops, number of leaves at the time of harvesting, yield of intercrops and biomass production (Table 3).

Table3: Morphological characters and yield of intercrops

Treatment	Height of the intercrop at the time of harvesting	No. of leaves of intercrop at the time of harvesting	Yield of the intercrop	Biomass production of the intercrop	
T1- Banana + Colocasia	82.00	15.00	10.70	103.75	
T2- Banana + Elephant Foot Yam	150.75	1.50	13.90	2606.25	
T3- Banana + Arrowroot	140.75	16.00	16.40	252.25	
T4- Banana + Ginger	60.75	9.75	6.20	114.75	
T5- Banana + Mango ginger	74.25	8.25	7.60	238.25	
T6- Banana + Turmeric	80.25	6.25	9.30	183.75	
T7- Control	0.00	0.00	0.00	0.00	
	SEM±	26.19	2.86	155.38	
	CD 5%	77.78 (S)	7.45(S)	8.50(S)	461.38(S)

This type growth behaviour is due to different type of intercrops with different growth habit. Maximum height of intercrops was observed with elephant foot yam and the minimum with ginger, number of leaves was maximum with arrow root and the minimum with elephant foot yam. Yield of intercrops was highest in arrow root 16.40t/ha and the minimum with ginger i.e; 6.20 t/ha and the maximum biomass was produced with elephant foot yam and the lowest with ginger. It was observed that the growths of the intercrops were normal and the banana plantation did not get affected by the growth behaviour of the intercrops. The present findings is supported by the study of [6] who reported

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that 5000-9000 plants of elephant foot yam per hectare can be accommodated between the interspaces of fruit and orchard crops and elephant foot yam is not competing for light as this crop is able to tolerate shade. This study is again supported by [7] who reported that Nendran banana, Elephant Foot Yam, Ginger can be grown as suitable intercrops in coconut garden in different combinations.

The yield of individual intercrops, return from intercrops, yield of banana and return from banana were calculated to get the total return from banana were calculated to get the total return from banana intercropping system (Table 4).

Table 4: *Benefit: cost ratio of banana based intercropping system*

Treatment		Cost of cultivation of intercrop (Rs)	Cost of cultivation of banana (Rs)	Total cost of cultivation (Rs)	Net return (Rs)	Net profit (Rs)	Benefit : Cost ratio
T1	Banana+ Colocasia	105000	248700	353700	664000	219550	1.87
T2	Banana + Elephant foot Yam	115200	248700	363900	783750	339300	2.15
T3	Banana+Arrowroot	105000	248700	353700	843200	398750	2.38
T6	Banana + Ginger	105000	248700	353700	676400	231950	1.91
T5	Banana + Mango Ginger	105000	248700	353700	672450	228000	1.90
T6	Banana + Turmeric	105000	248700	353700	810900	366450	2.29
T7	Control		248700	248700	444450	195750	1.78

The return over control varied depending on the yield and rate of the economic products of the intercrops. It was observed that even though the yield of Colocasia was more as compared to ginger, mango ginger and turmeric but, the return was more from ginger, mango ginger and turmeric as the rate per kg of these products are more than that of colocasia. It was observed that return from banana+arrow root was more followed by banana+turmeric. By considering the return from banana under different treatments, it was found that total return from banana+arrow root was more followed by Banana+Turmeric and the least was with banana alone. The similar trend was also observed for return over control. The present finding gave a better economic return as compared to sole crop of banana The present result also confirm with the findings of [8] in coconut, [9] under mango and [10] with Banana.

From the experiment due to high rate and cost of planting materials the cost of cultivation of elephant foot yam was more as compared to other intercrops. The total cost of cultivation for both intercrops and banana is presented in table 5.

Table 5: *Economics of production per hectare for banana plus intercrop*

Treatment		Intercrop yield (t/ha)	Return from intercrop (Rs.)	Yield of Banana (t/ha)	Return from banana (Rs.)	Total Return (Rs)	Return over control (Rs.)
T1	Banana+ Colocasia	10.7	214000	30	450000	664000	219550
T2	Banana + Elephant foot Yam	13.5	337500	29.75	446250	783750	339300
T3	Banana+Arrowroot	16.4	410000	28.88	433200	843200	398750
T4	Banana + Ginger	6.2	248000	28.56	428400	676400	231950
T5	Banana + Mango Ginger	7.6	228000	29.63	444450	672450	228000
T6	Banana + Turmeric	9.3	372000	29.26	438900	810900	366450
T7	Control			29.63	444450	444450	0

It was observed from the data that highest cost of cultivation was found with Banana + Elephant foot yam (3.639 lakhs) followed by around 3.537 lakhs in Colocasia, arrowroot , ginger, mango- ginger and turmeric. But, in control when banana was alone grown, the total cost of cultivation was around 2.487 lakhs/ hectare. Cost of cultivation of both intercrops and banana was taken into consideration and the corresponding gross return and net return was found out during the experiment. The gross return from both intercrops and banana is presented in table 5. It was seen from the tabulated data that highest gross return of 8.432 lakhs was obtained from Banana + Arrowroot. Rs.8.109 lakhs from

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Banana + Turmeric Rs. 7.8375 from Banana + Elephant Foot Yam, Rs. 6.764 lakhs from Banana + Ginger, Rs. 6.7245 lakhs for Banana + Mango ginger, Rs. 6.64 lakhs from Banana + Colocasia and Rs.4.444 lakhs from banana alone. The net profit from both banana with intercrop and banana alone is presented in table 7. It was found that highest net profit of Rs.3.9875 lakhs was obtained from Banana + Arrow root intercropping followed by Rs.3.6645 lakhs with Banana + Turmeric, Rs.3.393 lakhs with Banana + Elephant Foot Yam, Rs.2.3195 lakhs with Banana + Ginger, Rs.2.28 lakhs with Banana + Mango ginger, Rs.2.1955 lakhs with Banana + Colocasia and Rs.1.9575 lakhs with banana alone.

It was observed that as compared to control, a banana crop with varied combination of intercrops is giving more return depending on yield and prevailing cost of the produce. As compared to control where around Rs. 2 lakhs was profit per hectare in banana a two fold increase i.e; around Rs. 3.98 lakhs was obtained with banana+arrow root intercropping followed by turmeric. The benefit cost ratio during growing banana with inter crop and banana as sole crop is given in table 5. It was observed that highest benefit: cost ratio of 2.38

was obtained with Banana + Arrowroot, followed by 2.29 with Banana + Turmeric, 2.15 with Banana + Elephant Foot Yam, 1.19 with Banana + Ginger, 1.90 with Banana + Mango ginger, 1.87 with Banana + Colocasia, but the lowest with banana alone i.e;1.78 only. The present findings are in accordance with the report of [11] and [12].

By taking into consideration the B:C ratio in the present experiment it can be concluded that banana+arrow root (B:C ratio 2.38) is the best combination for more economic return as compared to banana+turmeric (B:C ratio 2.29) and banana+elephant foot yam (B:C ratio 2.15) intercropping than others under coastal humid agroclimatic condition of Bhubaneswar.

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