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Intercropping vegetables and pulses in black pepper (*Piper nigrum* L.)

THANKAMANI CK* • SRINIVASAN V • KANDIANNAN K • KRISHNAMURTHY KS

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ABSTRACT

An experiment was conducted with the objective of enhancing the income from black pepper garden by inter cropping vegetables and pulses at experimental farm of Indian Institute of Spices Research, Peruvannamuzhi, Kerala for two years. Vegetables namely Abelmoschus esculentus *(Okra), Lycopersicon esculentum (Tomato), Solanum melongena (Brinjal), Amaranthus spp. red and green, Capsicum annum (chilli), pulses such as Vigna ungiculata (cowpea), Vigna radiata (green gram) Vigna mungo (black gram),* Macrotyloma uniflorum *(horsegram) were chosen as intercrops and planted in the interspaces of four black pepper plants . Treatments were laid out in RBD with four replications and plot size was 3 x 1 m. The results indicated that height of black pepper plants was more under intercropping situation compared to sole crop of black pepper. Yield (5000 kg/ha), net income (Rs. 55,000) and B:C ratio (2.8) were highest for Amaranthus spp. green followed by Amaranthus spp. red.*

INTRODUCTION

Black pepper (*Piper nigrum* L.), known as 'King of spices' and 'Black gold' is one of the important foreign exchange earner for the country. India has 38% global area which contribute 15% global production with a productivity of 274 kg/ha. Newly planted gardens are often subjected to soil erosion, when it is devoid of vegetation, or heavy weed growth resulting in enhanced labour requirement. In addition to this, when pepper spaced at 3 x 3 m, the light energy reaches the ground and get wasted. Pepper as a sole crop does not fully utilize the natural resources such as soil, space and light. Black pepper roots extend up to about 90 cm from the base and effective root zone of black pepper reported to be 30 cm radius [9]. The inter-space could be effectively utilized for growing intercrops. The studies conducted by [11] has indicated that cultivation of crops such as Greater yam, Amorphophallus, Hybrid napier, Guinea grass are suited in juvenile black pepper garden . Among medicinal plants intercropped in black pepper garden, better returns were obtained from intercrops like *Crysopogon zizanioids* (vetiver*), Alpinia calcarata (Galangal)* and *Asparagus racemosus (shawtavari)* [12].

The growth of pepper vine is slow during initial years, and financial return to farmers is also meager from young garden. Crop diversification in juvenile black pepper garden is essential as pepper growers are facing recurring problems. Hence, interspaces can be effectively utilized for growing

*Corresponding author, Email: thankamani@spices.res.in
Indian Institute of Spices Research. Calicut- 673012, Kerala.

pulses/vegetables which can use the interspaces as pepper plants will be very small.

Vegetables and pulses which play important role in maintaining good health are better choices for intercropping owing to their short duration and their demand. In addition, pulses enrich the soil fertility by fixing atmospheric nitrogen and improve soil structure [1]. Selection of suitable vegetables and pulses to increase the income of farmer is highly essential. Hence, an experiment was conducted to study the possibility of intercropping of vegetables and pulses in young black pepper garden.

MATERIALS AND METHODS

Present study was conducted at experimental farm of Indian Institute of Spices Research, Peruvannamuzhi, Kozhikode during 2007-2009. The station lies between 11° 34' North and 75° 48' East longitudes. It is situated at an altitude of 60 above MSL and enjoys a tropical climate. The station receives an annual rainfall of around 4500 mm, maximum and minimum temperature is of 36^0 C and 21^0 C respectively. The soil of experimental site is forest loam, with a pH of 4.6, 125 ppm available nitrogen, 0.20 ppm available phosphorous and 150 ppm available potassium respectively. The support used for black pepper was *Glyricidia sepium*, planted a year early at a spacing 3 m x 3 m, in the experimental site. Pits of 50 cm x 50 cm x 50 cm sizes were taken at the basin of the standard and planting of the variety Panniyur-1 was done during June 2007. Vegetables namely Okra (Salkeerthi), tomato, brinjal (Swetha), amaranthus red (Kannara local), amaranthus green (Co 1), chilli (Jwala), pulses such as cowpea (C 152), greengram (Co 6), blackgram (Co 5), horsegram were chosen as intercrops. Treatments were laid out in RBD with four replications and the plot size was 3 x 1 m.

Recommended package of practices of [6] were followed for these crops. The intercrops were planted during February-March in the interspaces of four black pepper plants. The schedule followed for cultivation of different crops is given in Table 1. Soil samples were collected after the experiment and soil nutrient status was estimated by standard procedures. To determine the available nitrogen Kjeldahl method was used [10]. Phosphorus was determined by Bray method [3]. Potassium was determined by Atomic Absorption Spectro photometer [4]. Photosynthetically active radiation (PAR) received in the garden was measured using portable photosynthesis system (LCA 4). PAR received in open condition varied from 1800 - 1900 μ mol m^{-2} sec^{-1} and the filtered light varied from 1300-1500 μ mol where different inter crops were grown. Main crop as well as inter crops were supplied with recommended fertilizers and other operations were carried out as and when required.

Table 1. Agro techniques adopted for vegetables and pulses raised in the black pepper

Crops	Spacing (cm)	Planting material
BP + Okra	60x30	Seeds
BP + tomato	60x60	Seedlings
BP + brinjal	60x60	Seedlings
BP + amaranthus red	25x25	Seedlings
BP + amaranthus green	25x25	Seedlings
BP + chilli	45x45	Seedlings
BP + cowpea	25x25	Seeds
BP + greengram	25x25	Seeds
BP + blackgram	25x25	Seeds
BP + horsegram	25x25	Seeds
BP (Sole crop)	3x3m	Rooted cuttings

BP- Black Pepper

The economic produce were harvested as and when ready and quantified per hectare of black pepper garden and their cost of cultivation was worked out. Farm gate prize was used for computing gross and net returns (Table 1). Benefit cost ratio was calculated by dividing net income by cost of cultivation. Data was statistically analyzed by the procedure given by [7].

RESULTS AND DISCUSSION

Intercropping Amaranthus spp. green with black pepper recorded maximum yield (5000 kg/ ha) followed by Amaranthus spp. red (4500 kg/ ha). Regarding economics it could be seen that

the net income was the highest in crop combination consisting of black pepper + Amaranthus spp. green (Rs. 55,000) followed by black pepper + Amaranthus spp. red (Rs. 47,500) . Among pulses Black pepper + green gram and Black pepper + blackgram recorded maximum net income (Rs 19500). This could be due to higher inter crop yield. Wide variation in net return among intercrops was noted due to variation in the cost of cultivation. All the inter crops had B: C ratio more than 1, which indicated suitability of vegetables and pulses for intercropping in black pepper garden. With regard to benefit-cost ratio Amaranthus spp. green recorded maximum (2.8) followed by Amaranthus spp. red (2.3). Among pulses Black pepper + green gram and Black pepper + blackgram recorded maximum B:C ratio (1.5).

The better performance of the intercrops may be due to better utilization of natural resources like light(medium shade), space, nutrients etc than that of sole crop of black pepper. The research findings by [11] also revealed suitable microclimate in juvenile black pepper garden for the cultivation of *Amorphophallus* (Gajendra), greater yam (Sree Keerthi), ginger (Varada), turmeric (Prathiba), hybrid Napier grass Co 3, Guinea grass and Congo signal grass. Among different cropping systems tried in coconut garden, coconut + vegetable intercropping system (Coconut+ amaranthus/ bendi) recorded significantly higher coconut productivity [2]. Profitable cultivation of brinjal in young arecanut garden is also reported [8].

Height of black pepper plants was not affected by intercrops. Intercropping of cowpea increased black pepper height by 40% over control. Increased height in black pepper over control suggested that the intercrops may not have competed with the main crop, rather, it acted synergistically which may be due to the additional input black pepper received in terms of fertilizer and better weed control. The result is in agreement with the findings of [11] and [12] in black pepper and [5] in cashew. Better utilization of nutrients by black pepper might have resulted in increased growth.

SOIL NUTRIENT STATUS

Soil nitrogen status was high in the plots in which pulses were cultivated (Table 3). Nitrogen content was higher in intercropped plots compared to sole crop of black pepper. Maximum nitrogen content was observed in the treatment Black pepper + cowpea (143 ppm) followed by black pepper + horsegram (137 ppm). Intercropped plots had significantly higher potassium content than

Table 2. Economics of intercropping vegetables and pulses in black pepper (Average of two years)

Intercropping system	Yield of inter crops kg/ha	Gross income (Rs/ha)	Cost (Rs/ha)	Net income (Rs/ha)	B:C ratio	Height of black pepper (cm)
BP + Okra	2500	40000	19571	20429	1.0	151
BP + tomato	2700	43200	17000	26200	1.5	140
BP + brinjal	3240	51840	18800	33040	1.8	150
BP + amarathus red	4500	67500	20000	47500	2.3	153
BP + amarathus green	5000	75000	20000	55000	2.8	150
BP + chillies	2160	38880	19168	19712	1.0	145
BP + cowpea	550	28600	14000	14600	1.0	190
BP + greengram	500	30000	13000	19500	1.5	168
BP + blackgram	500	30000	13000	19500	1.5	154
BP + horsegram	650	27950	12000	15950	1.3	187
Sole Black pepper	-	-	-		-	130
CD (0.05)	57.0	-	-	-	-	23.9

BP -Black pepper

sole crop of black pepper. Maximum potassium content was observed in the crop combination black pepper + amaranthus red followed by black pepper + amaranthus green. This result corroborate the findings by [11] who observed high nutrient status in black pepper garden intercropped with tuber and fodder crops. In the present experiment fertilizer was given to main as well as inter crops that would have helped in avoiding competition between the crops.

Table 3. Post harvest nutrient status in black pepper garden intercropped with vegetables and pulses.

Intercropping system	pH	N (mg/kg)	P (mg/kg)	K (mg/kg)
BP+Okra	4.4	119	0.17	178
BP+tomato	4.4	123	0.17	179
BP+brinjal	4.7	121	0.17	182
BP+ amarathus red	5.3	132	0.19	194
BP+amarathus green	4.4	130	0.18	185
BP+chilli	4.5	122	0.17	178
BP+cowpea	4.9	143	0.19	186
BP+greengram	4.6	135	0.18	175
BP+blackgram	4.5	133	0.19	186
BP+horsegram	4.8	137	0.18	180
Sole Black pepper	4.5	120	0.18	173
CD(0.05)	0.3	3.8	NS	4.3

BP-Black pepper

CONCLUSION

The present investigation indicated that intercropping vegetables and pulses can provide income to the farmer during pre-bearing stage of black pepper to the tune of Rs 15,950 to Rs 55,000. Intercropping enhanced height of black pepper. All crops tested are suitable; however, better returns were obtained from intercrops like Amaranthus spp. green, Amaranthus spp. red and Brinjal.

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