Indian J. Hort. 68(1), March 2011: 71-74

Impact of basin irrigation on black pepper production in coffee based cropping system in high altitude regions of Kodagu, Karnataka

S.J. Ankegowda*, M.N. Venugopal, K.S. Krishnamurthy and M. Anandaraj
Indian Institute of Spices Research, Cardamom Research Centre, Appangala, Madikeri 571 201, Karnataka

ABSTRACT

Experiments were conducted at high altitude (1000 m above MSL) in coffee based cropping system in two plantations in Kodagu, Karnataka. The basin irrigation @ 50-60 litres per vine was given through hose after harvest from March 15th onwards once in 15 days up to May 15th in irrigated block and the quantity of water was adjusted based on the rainfall of preceeding week. In irrigated area, new leaves and spikes emerged uniformly in May last week-June first week followed by setting in June. In rainfed area, new leaves and spikes emerged in July-August. Number of spikes per m^2 and number of berries per spike recorded significant variation between irrigated and rainfed treatments in both the locations. Incidence of anthracnose and spike shedding was less in irrigated vines compared to rainfed vines. At 6 metre height of vine, number of spikes per m^2 was 160.9 at Boikeri and 233.8 at Hosakeri in irrigated treatment, whereas it was 32.5 at Boikeri and 51.4 at Hosakeri in rainfed treatment. Number of berries per spike doubled in irrigated vines compared to rainfed vines in both locations. Mean berry yield per vine was 6.3 kg per vine in irrigated treatment and 1.9 kg per vine in rainfed treatment. The results clearly indicate that basin irrigation of pepper vines during March-May and shade regulation in April help in early initiation of spikes and good setting. In high elevation, in an year of pre monsoon failure black pepper needs to be irrigated in summer to harvest good crop in coffee based cropping system where black pepper is a mixed crop.

Key words: Anthracnose, basin irrigation, black pepper, coffee-based cropping system.

INTRODUCTION

Black pepper (*Piper nigrum* L.) is originated in the tropical evergreen forests of Western Ghats in India. India has the largest area under black pepper and is grown under varied cropping and climatic conditions. The mixed crop of coffee and black pepper is a common practice in many traditional coffee growing regions of Karnataka. The performance of the varieties depends on local climatic conditions, management methods, pest and disease complex, *etc*. (Bhagavantagoudra *et al*., 1; Kandiannan *et al*., 2; Krishnamurthy and Chempakam, 3). In hilly regions, crop failure due to spike shedding, anthracnose and moisture stress have been reported particularly in rainfed mixed crop (Kurian *et al*., 4,7). Due to delayed monsoon and moisture stress the popular released varieties like Panniyur-1 is not yielding under misty, cloudy, high altitude coffee based cropping systems (Bhagavantagoudra *et al*., 1). The possibility of promoting early spiking and yield in Panniyur-1 through basin irrigation in pre-and early monsoon period was tested in two hot spots of spike shedding in Kodagu district, Karnataka.

MATERIALS AND METHODS

The experiments were conducted during March-June in high altitude (1000 m above MSL) in coffee based cropping system in two plantations (Sandalkad Estate, Boikeri and Fair Field Estate, Hosakeri) in Kodagu, Karnataka. The pepper was trained on silver oak (*Grivelia robusta*) and palwan (*Erythrina*). The area was divided into two blocks, one irrigated and another rainfed. Age of the vine was 12-15 years. The basin irrigation with hose @ 50-60 l was given after harvest from March 15th onwards once in 15 days up to May 15th in irrigated block and the quantity of water was adjusted based on the rainfall of preceding week. Shade was regulated in April in both the blocks. The number of spikes per m^2, number of laterals (fruiting branches) per m^2 and number of leaves per m^2, spike length (cm), and the number of berries per spike were recorded at 3 and 6 m height of vine at end of cropping season in both the plantations. The dry yield per vine was recorded. The time of emergence of spike, spike shedding and anthracnose incidence were monitored from May onwards. For both the blocks recommended package of practices for coffee + pepper cropping system and recommended disease control measures were followed (1 % Bourdeaux mixture spray in June and September and drenching with 0.2 per cent copper oxychloride was undertaken in June). Manures and fertilizers were applied as per the package. The results were analysed using Student's 't' test.

*Corresponding author's present address: Indian Institute of Spices Research, Calicut 673 012, Kerala; E-mail: gowda@spices.res.in

RESULTS AND DISCUSSION

The rainfall distribution plays an important role in black pepper production in addition to total rainfall. Mean monthly rainfall recorded in both the locations is presented in Table 1. The total rainfall was 1874 and 1401.25 mm in Boikeri and Hosakeri respectively. Sandalkad estate, Boikeri received 136.5 mm of rainfall by May end and Fair field estate, Hosakeri received 215.25 mm (around 80 mm higher compared to Boikeri) rainfall during the same period. Pradeepkumar *et al.* (5) reported that there was a significant correlation between rainfall received during May (amounts to 100 mm to attain field capacity during first half of May) with yield in black pepper (r = 0.75).

Table 1. Mean monthly rainfall (mm) in misty high altitude situation at in Sandalkad and Fair field estates in Kodagu district, Karnataka (2003 data).

Month	Rainfall (mm)	
	Sandalkad Estate, Boikeri	Fair field Estate, Hosakeri
January	0.00	0.00
February	0.00	35.00
March	24.50	26.00
April	112.00	144.25
May	0.00	10.00
June	421.75	248.25
July	480.00	393.75
August	563.50	338.25
September	108.75	61.00
October	163.50	129.75
November	0.00	15.00
December	0.00	0.00
Total	1,874.00	1,401.25

Ideal conditions, early rainfall (approx. 400 mm rainfall by May end and clear sky during April-June leads to production of spikes in June, good setting of spike and high yield).

In irrigated area, new leaves and spikes emerged uniformly in May last week-June first week followed by setting in June. New leaves and spikes emergence was not much in July-August where shade was regulated. But in irrigated area with excess shade, only a few new leaves and spikes emerged in June and set in to fruits. Next cycle of new leaves and spikes emerged in July-August. In rainfed area, new leaves and spikes emerged only in young vines during May-June. In old vines, staggered new leaves and spikes emerged in July-August. Anthracnose and spike shedding incidence was more. New leaves and spikes were infected with anthracnose and partial setting of spikes and extensive spike shedding were noticed. Spike shedding varied considerably between irrigated (9-23%) and rainfed treatments (47-85%) (Tables 2,3).

In Sandalkad estate, Boikeri, number of laterals per m^2, number of leaves per m^2 and spike length did not record significant variation between 3 and 6 m height of vine (Table 2) but the number of spikes per m^2 and number of berries per spike recorded significant variation. The mean number of spikes at 3 and 6 m height was 127.6 and 160.9 per m^2 respectively in irrigated block. In rainfed block, mean number of spikes at 3 and 6 m height was 29.2 and 32.5 per m^2 respectively. Mean number of berries per spike was 109.24 in irrigated block and 52.23 in rainfed block. Per cent anthracnose disease index was 20 an irrigated block and 50 in rainfed block. Per cent spike shedding was 78.5 in rainfed block.

In Fair field Estate, Hosakeri, number of laterals per m^2 vine and number of leaves per m^2 did not recorded significant variation between 3 and 6 m vine height (Table 3) but the number of spikes per m^2, spike length and number of berries per spike recorded significant variation. The mean number of spikes at 3 and 6 m height was 188.4 and 233.8 per m^2 respectively in irrigated block. In rainfed block, mean number of spikes at 3 and 6 m height was 41.4 and 51.4 per m^2, respectively. Mean number of berries per spike was 126.3 in irrigated block and 29.7 in rainfed block. Mean spike length was 18.75 and 14.5 cm in irrigated and rainfed blocks respectively. Per cent anthracnose disease index was 17.5 irrigated block and 37.5 in rainfed block. Per cent spike shedding was 10 in irrigated block and 65 in rainfed block. The mean dry yield per vine in irrigated block was 6.3 kg/vine, whereas it was 1.8 kg per vine in rainfed block.

The results from both the plantations clearly indicate that premonsoon irrigation has a significant positive impact on spike production and yield. The yield increase in irrigated block was more than three-fold compared to the rainfed block. Berry number per spike in rainfed block was half that of irrigated block in Sandalkad Estate, while it was less than ¼ in Fair field Estate. The low number of berries per spike in rainfed block is due to partial setting of spike which implies that delayed spiking may lead to partial setting. Low spike intensity in rainfed situation is due to staggered and delayed spiking, lower bisexual flowers, anthracnose incidence and spike shedding. Earlier workers also have reported lower number

Table 2. Influence of basin irrigation on yield parameters of black pepper in Sandalkad Estate, Boikeri.

Treatment	No. of laterals/m^2		No. of leaves/ m^2		No. of spikes/m^2		Spike length (cm)	No of berries/ spike	% Anthracnose disease index		% Spike shedding		Dry yield (kg/vine)
Position of vine	6 m	3 m	6 m	3 m	6 m	3 m			6 m	3 m	6 m	3 m	
Irrigated	24.5	17	310.3	271.9	160.9	127.6	16.0	109.14	17	23	16	23	6.2
Rainfed	23.9	21	280.9	284.1	32.5	29.2	11.63	52.23	47	54	72	85	1.8
t-test	NS	NS	NS	NS	**	**	NS	**	*	*	*	*	**

*,** Significant at 5 and 1% levels.

Table 3. Influence of basin irrigation on yield parameters of black pepper at Fair Field Estate, Hosakeri.

Treatment	No. of laterals/m^2		No. of leaves/ m^2		No. of spikes/ m^2		Spike length (cm)	No. of berries/ spike	% Anthracnose disease index		% Spike shedding		Dry yield (kg/vine)
Position of vine	6 m	3 m	6 m	3 m	6 m	3 m			6 m	3 m	6 m	3 m	
Irrigated	21.3	16.9	263.3	250.4	233.8	188.4	18.75	126.3	14	21	9	11	6.3
Rainfed	19.89	17.2	241.8	231.6	54.5	41.4	14.5	29.7	34	41	58	72	1.9
t-test	NS	NS	NS	NS	*	*	NS	**	*	*	*	*	*

*,** Significant at 5 and 1% levels.

of berries in rainfed situation and is attributed to delayed spiking, lower number of bisexual flowers and partial setting (Ravindran *et al.,* 6).

The study also indicates that anthracnose and spike shedding can be controlled by premonsoon irrigation. Unlike other crops in susceptible black pepper cultivars only tender leaves readily take *Colletotrichum gloeosporiodes* infection. Synchrony in production of new leaves and spiking and early maturity may be the reason for lower disease index in Panniyur-1 under irrigated conditions. This study clearly indicates that promoting early spiking and setting is the best strategy to overcome anthracnose infection.

It is clearly indicated that basal irrigation of pepper vine during March-May and shade regulation in April helps in early initiation of spikes and good setting. Thus, based on the results of the study, it is suggested to irrigate black pepper during summer months in years of premonsoon failure to harvest good crop in high altitude in coffee-based cropping system where black pepper is grown as mixed crop. Early production of spikes and new leaves resulted in field tolerance to anthracnose.

REFERENCES

1. Bhagavantagoudra, K.H., Sheshagiri, K.S., Venkateshmurthy, P. and Dineshkumar, M. 2008. Performance of black pepper varieties in coffee based cropping system. *Karnataka J. Agric. Sci.* **21**: 256-58.
2. Kandiannan, K., Krishnamurthy, K.S., Thankamani, C.K. and Mathew, P.A. 2007. Pattern and variability of black pepper yields in tropical humid climatic conditions. *Indian J. Hort.* **64**: 314-19.
3. Krishnamuthy, K.S. and Chempakam, B. 2009. Investigation on the influence of seedling's physiological attributes on productivity in black pepper. *Indian J. Hort.* **66**: 95-100.
4. Kurian, P.S., Joseph Rajkumar, A., Backiarani, S. and Murugan, M. 2000. Case study of pollu disease epidemic of black pepper in high ranges of Idukki district. **In**: *Proceedings of 12th Kerala Sci. Congress*, January 2000, Kumily, pp. 497-98.
5. Pradeepkumar, T., Vasanthakumar, Apie, K.C., Kumaran, K., George, S.P., Manmohandas, T.P. and Anith, K.N. 1999. *Indian J. Arecanut, Spices Medicinal Plants*, **1**: 88-90.
6. Ravindran, P.N., Nirmal Babu, K., Sasikumar, B. and Krishnamoorthy, K.S. 2000. Botany and crop

improvement of black pepper **In**: Black Pepper (*Piper nigrum*), Ravindran, P.N., (Ed.), Harwood Academic Publishers, The Netherlands, pp. 22-142.

7. Kurian, P.S., Sivakumar, G., Joseph Rajkumar , A., Backiyarani, S., Murugan, M. and Shiva, K.N. 2008. Management of anthracnose disease (*Colletotrichum gleosporiodides*) Penz (Penz&Sac.) of black pepper (*Piper nigrum* L.) in the high ranges of Idukki district, Kerala. *J. Spices Aromatic Crops,* **17**: 21-23.

Received: March, 2009; Revised: December, 2010; Accepted : January, 2011