Indian Journal of Ecology (2023) 50(5) (SI): 1719-1721
DOI: https://doi.org/10.55362/IJE/2023/4124

Manuscript Number: 4124
NAAS Rating: 5.79

Studies on Integrated Nutrient Management in Black Pepper under Agroforestry System

Arsha Riyaz, S.S. Inamati and Divya Soman

University of Agricultural Sciences, Dharwad-580 005, India
E-mail- arshariyaz6@gmail.com

***Abstract*:** Black pepper (*Piper nigrum* L.) is one of the oldest and most expensive spices ever known to mankind.. An experiment was conducted in 2022-23 with the objective of studying the effect of integrated nutrient management on the yield and quality parameters of black pepper under agroforestry system. The application of 75% RDF + *Azospirillum* (50 g) +PSB (50 g) +VAM (100g) per vine reported a greater performance on yield and yield attributing parameters. The number of spikes ranged from 36 to 103 and their lengths from 4.9 to 14.5. The number of berries per spike and dry yield of black pepper per vine ranged from 26 to 81 and 76.6 to 403 grams. The minimum values for the studied parameters were in the control. Black pepper quality parameters viz., oleoresin and piperine content were not affected by different nutrient management practices except for the control. The present study indicated that yield parameters differed significantly with different nutrient management practices.

***Keywords*:** Black pepper, Piperine, Oleoresin, Agroforestry system, *Piper nigrum* L.

Agroforestry is an age-old practice in India which combines woody perennials along with crops and /or animals on the same unit of land management. Black pepper *(Piper nigrum* L.*)* is one of the oldest and most expensive spice ever known to mankind. It is prized for its aroma, which results from the presence of essential oil within the berries, and for its pungency, which results from the principal alkaloid piperine. Black pepper is cultivated for its fruits, which are typically dried and used as spice. It is chiefly used in traditional medicines and for culinary uses (Ravindran et al 2000) and is traditionally cultivated under a few support trees like coconut and areca nuts (conventional species). Numerous MPTs (multipurpose tree species) are also appropriate for pepper block growing. Silver oak (*Grevillea robusta*) is a member of the Proteaceae family. It is indigenous to Australia's east coast but is also widely distributed in India. Silver Oak tree provides timber, is used to make cricket bat, acts as a windbreak, provides shade for plantations and serves as a stake for climbers like pepper (Umashankar et al 2012). Coffee is one of the plantation crop cultivated and produced in India that contributes significantly in foreign money to the country's revenue. The two most prevalent species of coffee grown and consumed worldwide are Arabica coffee (*Coffea arabica*) and Robusta coffee (*Coffea canephora*). Recent trends shows that intense usage of fertilizers without considering adequate soil management practices contributes to global decline in soil productivity and fertility (Pannaga et al 2021). The forestry enterprise is increasingly utilizing the recently developed method of integrated nutrient management and improves productivity and soil properties, which benefits plant performance. Sustainable crop production is facilitated by an integrated approach to nutrient management, which improves soil organic matter and easily available plant nutrients. Organic manures and bio fertilisers can replace between 25 per cent and 50 per cent of chemical fertilisers now used (Kandeel et al 2002). Black pepper is a highly nutrient exhausting crop so the crop nutritional requirement should be considered seriously. The present investigation was carried out to study the influence of integrated nutrient management on the yield, yield attributing and quality parameters of black pepper under silver oak - black pepper-coffee based agroforestry system.

MATERIAL AND METHODS

The present study was carried out in Uttar Kannada district, Karnataka, where two year old black pepper vines were trailed on three year old silver oak trees. Silver oak trees were planted at a spacing of 3 m × 3m. In between two silver oak trees, two coffee plants were planted at a spacing of 1.2 m × 1.2 m between the coffee plants and 0.9 m × 0.9 m between the coffee plant and the silver oak tree. Coffee plants were two year old. The variety of coffee plant was *Coffea arabica,* while the variety of black pepper used was panniyur 2. The experiment was laid out in randomized block design with nine treatments and three replications. The treatments were applied for eight vines per replication. The various treatments adopted were:

$T_{1.}$ RDF (100:40:140g)

T_2- 50% RDF + (Azospirillum 50g +PSB 50g +VAM 100 g)
T_3- 75% RDF + (Azospirillum 50 g +PSB 50 g +VAM 100g)
T_4- 50% RDF + 50 % N in the form of vermicompost
T_5-50% RDF+ 50 % N in the form of FYM
T_6-75% RDF+ 25 % N in the form of vermicompost
T_7-75 % RDF+ 25 % N in the form of FYM
T_8-Farmer practice (10 kg FYM +5 kg Forest Litter)
T_9-Control

For every treatment except for control and farmers practice, additional 10 kg FYM per vine was applied. The details on RDF was collected from package of practice published by University of Horticultural Sciences, Bagalkot. The nutrients were applied in two split doses. In July first week of 2022, the first split was applied by creating ring basins surrounding each vine. The second split was applied in the month of November 2022. All the matured black pepper spikes from each replications were harvested towards the end of January 2023. Chemical fertilizers containing nitrogen, phosphorus, and potassium were applied in the form of urea (N), rock phosphate (P) and muriate of potash (K) according to the treatment instructions. Bio-fertilizers such as vesicular arbuscular mycorrhiza (VAM), phosphorus solubilizing bacteria (PSB) and *Azospirillum* culture were inoculated to FYM and applied to the black pepper vines according to the treatments. The forest litter application was in the form of leaf prunings (Silver oak). The various yield, yield attributing and quality parameters *viz.,* yield (g/vine), no of spikes per column, length of the spike (cm), no of berries per spike, fresh weight of spikes per vine (g/vine), piperine and oleoresin content were estimated and the averages were worked out. The harvested spikes were threshed, dried in open sun and dry weight was taken as yield per vine. The piperine content was estimated by UV spectrophotometer (Anonymous, 2005) while the oleoresin content was estimated by soxhlet apparatus (Ravindran et al 2000).

RESULTS AND DISCUSSION

The combined application of organic, inorganic, and bio-fertilizers had a significant impact on the yield and yield attributing parameters after seven months of experiment except for the test weight of 100 dried berries (Table 1). Among the treatments, T_3 [75 % RDF + *Azospirillum* (50 g) + PSB (50 g) + VAM (100 g)] recorded the highest, while T_9 (control) recorded least values for all the studied parameters. The test weight of 100 dried berries was non-significant for all treatments. High values for yield and yield attributes in black pepper *viz.,* number of spikes per vine (103.66), spike length (14.53 cm), number of berries per spike (81.66), fresh weight of spikes per vine (1443.33 g/vine) and dry yield (403 g/vine) may be attributed to quick supply of nutrients in the form of NPK. The vesicular arbuscular mycorrhiza might have improved the availability and absorption of all important nutrients which enabled more phosphorus uptake and accumulation in leaf tissues and enhanced the photosynthetic process, glucose translocation and accumulation. The dry yield was maximum for T_3(403 g/vine). Arya et al (2013) also revealed that a greater number of berries are produced from longer spikes and hence increases the yield. Vargese et al (2021) observed that the application of 100 % RDF +*Azospirillum* + PSB + VAM gave higher performance in terms of yield (2.5 kg/vine) and yield attributing factors. Non-significant result observed in test weight of 100 dried berries (5.02 g) of black pepper may be attributed to genotypic character of the cultivar used. The

Table 1. Yield, yield attributes and quality parameters of black pepper as influenced by different integrated nutrient management practices

Treatment	No. of spikes per vine	Spike length (cm)	No of berries per spike	Test wt. of 100 dried berries (g)	Fresh yield of spikes per vine (g/vine)	Dry yield (g/vine)	Oleoresin (%)	Piperine (%)
T_1	91.33	12.13	69.00	5.02	1233.33	351.66	7.37	2.34
T_2	93.66	12.50	71.33	5.02	1253.33	357.66	7.37	2.36
T_3	103.66	14.53	81.66	5.02	1443.33	403.00	7.38	2.32
T_4	86.33	10.16	62.33	5.02	857.00	269.33	7.36	2.34
T_5	74.00	7.80	47.66	5.02	767.66	192.00	7.37	2.35
T_6	84	9.93	55.66	5.02	853.00	262.33	7.36	2.35
T_7	76.66	8.80	48.00	5.02	768.70	226.66	7.35	2.35
T_8	47.33	7.50	40.00	5.02	399.00	172.66	7.37	2.33
T_9	36.66	4.93	26.33	5.02	287.00	76.66	6.83	2.13
Mean	77.07	9.80	55.77	5.02	873.47	256.88	7.30	2.31
CD (p=0.05)	2.49	0.41	5.09	NS	20.15	8.65	0.07	0.041

highest spike length was reported in T_3 (14.53). The enhancement of spike length could be possibly due to internodal elongation and cell expansion and growth The number of berries per spike was observed maximum in T_3 (81.66). This was mainly due to the longer spike length of T_3 spikes (14.53 cm).This was in line with Tripathi et al (2018).The fresh weight of spikes was maximum for T_3 (1443.33 g/vine) might be because of starch content, boldness and stage of harvest of the spikes. Sruthi et al (2013) also observed same trend. Statistically non-significant results were for piperine and oleoresin content under various nutrient combinations. The T_3 (7.38 %) and T_2 (2.36 %) recorded maximum oleoresin and piperine content respectively. Subramanian et al (2016) confirmed that black pepper quality parameters such as oleoresin and piperine content were not affected by different integrated nutrient management practices.

CONCLUSION

The study on integrated nutrient management in black pepper under silver oak-black pepper-coffee based agroforestry system indicates that integrated application of organic, inorganic and biofertilizers are good for yield of black pepper. The application of 75 % NPK + *Azospirillum* (50 g) +PSB (50 g) +VAM (100g) per vine are recommended for higher yield in black pepper.

REFERENCES

Anonymous 2005. *Piperine analysis in black pepper using spectrophotometric method*. American Spice Trade Association, USA, p 608.

Arya AK, Rajagopalan KN, Satheesan PK, Nair U, Mammotty KP and Zacharia G 2013. Panniyur-6 and Panniyur-7 high yielding black pepper selections for Kerala. *Indian Journal of Genetics and Plant Breeding* **63**(4): 363-364.

Kandeel AM, Nagla SAT and Sadek AA 2002. Effect of biofertilizers on growth, volatile oil yield and chemical composition of *Ocimum basilicum* L. *Annals of Agricultural Science* **47**: 351-371.

Pannaga T, Narayanpur VB, Hegde JS, Hiremath KG, Rathod V and Chandrakala R 2021. Evaluation of black pepper (*Piper nigrum L.*) cultivars for yield and quality parameters under hill zone of Karnataka. *Journal of Pharmacognosy and Phytochemistry* **10**(1): 1497-1500.

Ravindran PN, Balachandran I and Chempakam B 2000. End uses of pepper, pp 467-479. In: Ravindran PN (eds). *Black pepper* (*Piper nigrum L.*). Harwood Academic Publications, Amsterdam.

Sruthi D, Zachariah TJ, Leela NK and Jayarajan K 2013. Correlation between chemical profiles of black pepper (*Piper nigrum* L.) var. Panniyur-1 collected from different locations. *Journal of Medicinal Plants Resources* **7**(31): 2349-2357.

Subramanian P, Maheswarappa HP, Zachariah TJ, Surekha R, Selvamani V and Bhat R 2016. Performance of black pepper in coconut based high density multi-species cropping system under different nutrient managements. *Journal of Plantation Crops* **44**(2): 90-95

Tripathi PC, Karunakaran G, Sakthivel T, Ravishankar H, Chithiraichelvan R and Sulladmath V 2018. Selection and performance evaluation of black pepper clone suitable for Coorg region of Karnataka. *International Journal of Agricultural Science* **10**(12): 646-647.

Umashankar N, Venkateshamurthy P, Krishnamurthy R, Raveendra HR and Satish KM 2012. Effect of microbial inoculants on the growth of silver oak (*Grevillea robusta*) in nursery condition. *International Journal of Environmental Science and Development* **3**(1): 72-76

Varghese MJ, Paul PK and Marimuthu R 2021. Effect of integrated nutrient management on yield of black pepper. *Journal of Krishi Vigyan* **10**(1): 73-76.

Received 09 September, 2023; Accepted 04 November, 2023