Delineation of Soil fertility status and KVK intervention to improve the productivity of Pepper in TSP villages of Namakkal district under soil health card mission

Abstract

Soil is the most important resource needed for agriculture production. The unbalanced fertilizer application associated with more production by high yield varieties affects the soil quality vulnerably. Soils of tribal areas, having multi nutrient deficiencies due to intense cropping especially spices Pepper, coffee, cardamom and banana. Balanced application of plant nutrients is thus the only option to increase soil productivity for maintaining/enhancing the overall soil productivity. Delineation of soil nutrient status is an important practice to plan the nutrient scheduling for pepper crop. Hence 100 soil samples were collected from five adopted villages and tested its properties. Based on the analytical results, soil health cards issued along with fertilizer recommendation. Then 50 farmers were selected, trained all scientific package of practices through trainings. The field experiment was conducted in 50 farmer's field in an area of 20 ha. Panniyur 1 variety was test crop. Application of soil test based integrated nutrient management practice increased the yield attributes and yield of pepper. An average of Rs. 74,220/ha net profit could be obtained by adopting all scientific package of practices in the farm holdings.

Key words: soil nutrients status-delineation-scientific intervention-pepper yield-BC ratio

Introduction

Kollihills is a small mountain range located at the tail end of Eastern Ghats in the Namakkal of Tamil Nadu situated between 11.10' and 11.23' North Latitude and 78.17' and 78.28' East Longitude, the mountains are at 1000-1300 m height covering approximately 418.5 Km^2. There are 14 villages (Nadus/revenue villages) and 275 hamlets inhabited predominantly (>95 per cent) by scheduled tribes. The total population of Kollihills is 33888 living in 6480 households. Out of the 38678 people 36080 are Tribals and the rest have been declared as scheduled caste. The Malayali Malai Vazh Makkal is the major scheduled tribe's peoples living in this area.

The main occupation is agriculture and cattle rearing. Black Pepper, Hill Banana, Coffee, Pine apple, Tapioca, Paddy, Minor Millets like Foxtail Millet, Finger Millet and Little Millets are the Major crops cultivated in Kollihills in an area of 1200 ha under rainfed condition. Recent studies said that soil fertility status getting deteriorated due to poor nutrient management practice adopted by the farmers thus led to stunted growth, flower drops, fruit shedding and susceptible to pest and disease attack which in turn resulted in yield loss.

To assess the soil fertility and suggest suitable management practices delineation of soil nutrient status is important. Farmers being practicing nutrients application either through organic way and unbalanced amount of inorganic fertilizer application might be strongly associated with multinutrient deficiency. Right applications of essential nutrients are critically needed to increase pepper production and quality by the way of increasing growth and quality traits. Pepper yield is decreased tremendously and crops are more susceptible for pest and disease attack. To keeping these points in view, fertility status study was planned and implemented in adopted village of tribal areas. After testing, soil health card based fertilizer application promoted through integrated nutrient management. INM concept includes organic manures, biofertilizers application and inorganic fertilizers. Recently tribal farmers sensitized about biofertilizers especially azospirillum, phosphobacteria, vesicular Arbusicular Microrrhiza and arka microbial consortia. Microorganisms play a crucial role in mineralization and mobilization of nutrients in soil and facilitate the uptake by plants. Keeping all these points in view the present study was programmed.

Materials and Methods

Gundurnadu panchayat was selected in Kollihills and soil samples were collected in Elangiyampatti, Nathukulipatti, A.Thannimathipatti, Semmedu and Thambapadipatti villages. Soil samples were collected, brought to the laboratory air dried, processed and analyzed for physico-chemical, chemical, physical and biological parameters after passing through 2mm sieve. Soil pH and EC were determined in Soil: Water (1: 2.5ratio) extract by potentiometric and conductometric methods respectively (Jackson, 1973). Organic carbon was estimated by chromic acid wet digestion method (Walkley and Black, 1934). Available N in soil was estimated

by alkaline permanganate method (Subbiah and Asija, 1956), available P by Colorimetric method (Olsen *et al*., 1954), available K by Neutral Normal Ammonium Acetate method (Stanford and English, 1949), available S by Turbidimetric method (Williams and Steinbergs, 1959).

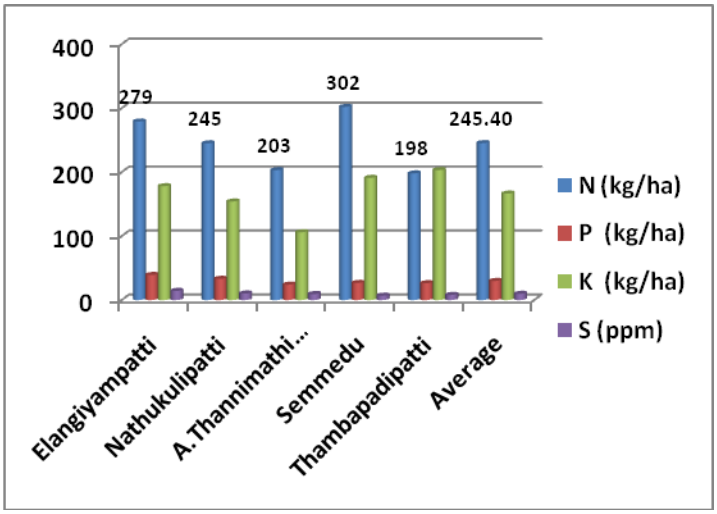
After the soil testing, importance of soil health was sensitized among farmers and farm women through various group meeting, awareness programme, field visits, regular advisories and distribution soil health cards with suitable recommendations. Then 50 interested farmers were selected and FLD programme with INM practice was implemented.

Among the various spices, pepper cultivated in larger scale for income generation and hence according to the soil fertility status nutrient management practices were suggested through integrated nutrient management concept in an area of 20 ha (50 farmers field) in randomized block design. Plot size was 0.5 acre (50 cents each) for check and 0.5 acre for INM demo. The plant population was maintained @ 1110 /ha. The treatment details as follows

Treatments	Details
Check - Farmers Practice	• Cattle manure @ 6 kg/ tree applied once in 6 months • Neem cake @ 250 g/ tree and complex fertilizers @ 100 g/ tree applied twice once 6 months interval
Demo – INM concept	• FYM/compost @ 10 kg/ tree/year in two splits @ 6 months interval • Azospirillum @ 50 kg, phosphobacteria @ 50 kg, potash solubilizing bacteria @ 50 g, & VAM @ 200 g along with 50 % recommended dose of chemical fertilizers (according to soil health cards) applied in split doses twice in circular basin excavated in 1 feet away from the base of the pepper vine during month of May - June and September - October months. • Lime @ 500g / tree applied once in two years during May-June immediately after the onset of monsoon.

After implementation of treatments, growth and yield attributes like length of spike, no. of spikes/vine, no. of berries/spike, pepper yield/vine (kg), pepper yield /ha (kg) were monitored through field visits and yield data & its attributes was collected and economics were worked out. Panniyur 1 pepper variety was taken as test crop for this experiment.

Results and discussion



Graph 1 : Concentration of Soil parameters present in different regions

Soil reaction nd Electrical conductivity

Predominant soil type was red sandy loam in texture and non calcareous in nature. From this soil analysis, analysis report revealed that value of soil reaction (pH) was ranged from 6.67 to 7.27 (Table 1). Climatic condition and topography played a vital role in decreasing soil pH. None of the soil samples having alkaline pH like plain soil. The decrease in pH might be attributed to the availability of higher amount of organic carbon. Release of organic and inorganic acids during decomposition of organic matter present in the hilly soils also directly contributed to the reduction of soil pH. Kaleem Abbasi & Ghulam Rasool (2005) also confirmed the above findings. Farmers in hilly areas doesn't have the tendency to dump more chemical fertilizers even right amount and leaching loss of salts by slopy nature of topography might be the reason behind in non saline nature. Soil electrical conductivity was found to be normal in all villages. The value recorded was 0.049 - 0.098 dS m^{-1}. The organic carbon content varied from 0.54 to 0.79 %. The highest 0.79 % OC of the hill soil might be due to prevalence of low temperature and accumulation of organic material in the top soil compared to plain soil (Navneet Pareek *et al*., 2019). Plain soils in Namakkal district always reported OC found to be in low to medium category and farmers who applied right dose of organic manures had medium category. The same was confirmed by repeated analysis in the Soil and Water Testing.

Soil Available nutrients

Available nitrogen content ranged from 198 to 302 kg ha^{-1} in all villages and average N value was found to be low category 245.50 kg ha^{-1}. Available phosphorus content recorded high category in all villages and average P content was 29.91 kg ha^{-1}. Regarding potassium status recorded low to medium category and have Similarity to N status. Available S content recorded low (6.78 pp) to medium (14.32 ppm) category and average S content was 9.76 ppm. Depletion of nutrients especially Nitrogen & Potassium from the running water during the heavy pour of rainfall might be associated with relatively less built up of nutrient in hilly soil. Indiscriminate use of chemical fertilizers and non inclusion of biofertilizers might be strongly contributed to the multinutrient deficiency in Hilly soils which in turn reflected in yield loss in farmers' practice in adopted villages. Wang *et al*., (2021) reported that land cover pattern, distance of sampling and topography played a vital role in increasing available nutrient status of soil.

Yield attributes and Yield of pepper

Yield and its attributes were found to be higher in KVK intervention than farmers practice. More No. of spikes was 209, length of spikes 14.3 cm, no. of berries/spike 89 and yield of dry berries/ vine was 1.66 kg observed in vines received all scientific packages of practices (Table 2 & Fig.1). Application of organic manures releases organic acids upon decomposition which mineralize the nutrients and make them available to plants. N fixing ability of bacteria, P & K solubilizing and mobilizing capacity bacteria materializes and increases the availability the nutrients from applied as well as native reservoir to the plants during requirement of various growth stage of pepper (Manju *et al*., 2021). Proper nutrient supplementation to all growth stages directly contributed the yield enhancement and hence INM treatments proved its superiority in terms of recording higher yield bearing attributes than previous years and check (Shilpa *et al*., 2017).

Economics of experiment

From this study it can be clearly stated that farmers got an additional income of Rs.74,220/ha by recording yield increase of 39.59% over check. Farmers sensitized about composting of locally available biodegradable waste, other organic manure preparation in their

field itself. Hence cost involved in OM, bio agents were not included in the cost of production. Biofertilizers cost, agro chemicals and labour cost were included in both practices. Hence scientific package of practices recoded higher BC ratio.

Upon field observation and survey carried out among farmers, it can be clearly stated that Quick wilt symptoms, yellowing of pepper vine and berry shedding at pin head stage was reduced upto16.8% when farmers adopted suitable scientific management practices especially during since May- June.

Conclusion

At this juncture, it can be concluded that soil fertility was comparably have less nutrient status and hence suitable management practices were suggested through KVK FLD programme. Farmers applied all the nutrient management practices and got appreciable yield bearing nature of pepper and recorded higher BC than conventional practice. Through this interventions, nearby farmers and villages were started to adopt complete scientific package of practice for pepper cultivation in hilly areas. Farmers experienced better through Tribal sub plan and now days significant changes in farming operations had been observed. They voluntarily buy biofertilizers from KVK and inculcated the habit of application of biofertilizers for pepper cultivation largely.

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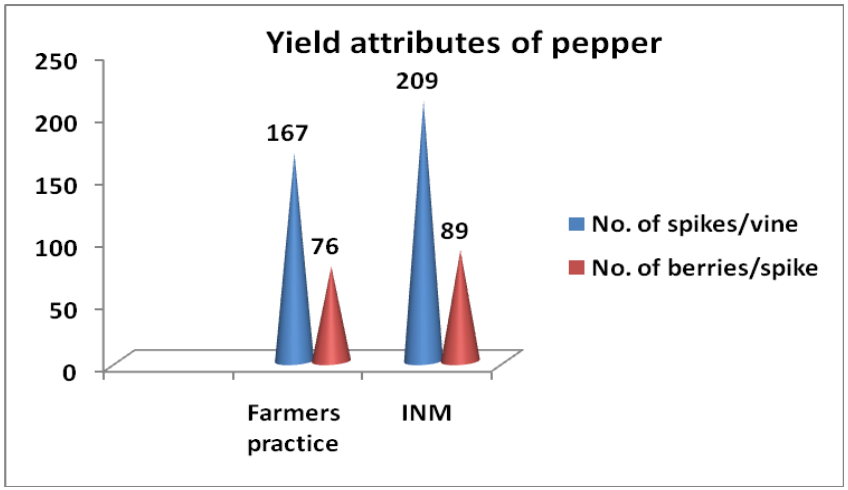
Table 1. Average nutrient status of Kollihills of Namakkal District, TN under Tribal Sub Plan & Soil Health Card Mission

Soil parameters			Average nutrient of Gundurnadu Panchayat of Kollihills block									
	Elangiyampatti N=28		Nathukulipatti n=15		A. Thannimathipatty N=15		Semmedu N=23		Thambapadipatti N=19		Average (100)	
Soil type	Red soil		Red soil		Red soil		Red soil		Red soil			
Soil texture	Sandy Loam		Sandy Loam		Sandy Loam		Sandy Loam		Sandy Loam			
Lime status	Non calcareous		Non calcareous		Non calcareous		Non calcareous		Non calcareous			
pH	6.98	Neutral	6.67	Neutral	7.27	Neutral	6.86	Neutral	7.09	Neutral	6.97	Neutral
EC (dSm^{-1})	0.089	Non saline	0.091	Non saline	0.049	Non saline	0.096	Non saline	0.098	Non saline	0.080	Non saline
Organic carbon (%)	0.79	H	0.69	M	0.56	M	0.78	H	0.54	M	0.67	M
Available nitrogen ($kg\ ha^{-1}$)	279	L	245	L	203	L	302	M	198	L	245.40	L
Available Phosphorus ($kg\ ha^{-1}$)	39.21	H	33.2	H	24.1	H	26.70	H	26.32	H	29.91	H
Available Potassium ($kg\ ha^{-1}$)	178	M	154	M	106	L	191	M	203	L	166.40	M
Available Sulphur ($mg\ kg^{-1}$)	14.32	M	10.23	M	9.43	L	6.78	L	8.02	L	9.76	L

Table 2. Yield attributes, yield & economics of black pepper

Treatments	Number of spikes	Length of spikes(cm)	Number of berries/spike	Yield (kg/vine)	Yield (kg/ha)	Cost of cultivation (Rs./ha)	Gross income Rs./ha)	Net income Rs./ha)	BC ratio
Farmers practice (check)	167	12.4	76	1.19	1321	1,34,560	3,05,010	2,03,000	2.26
KVK intervention	209	14.3	89	1.66	1844	1,46,900	4,24,120	2,77,220	2.89
CD (P=0.05)	13.498	0.840	3.689	0.130	121.813				



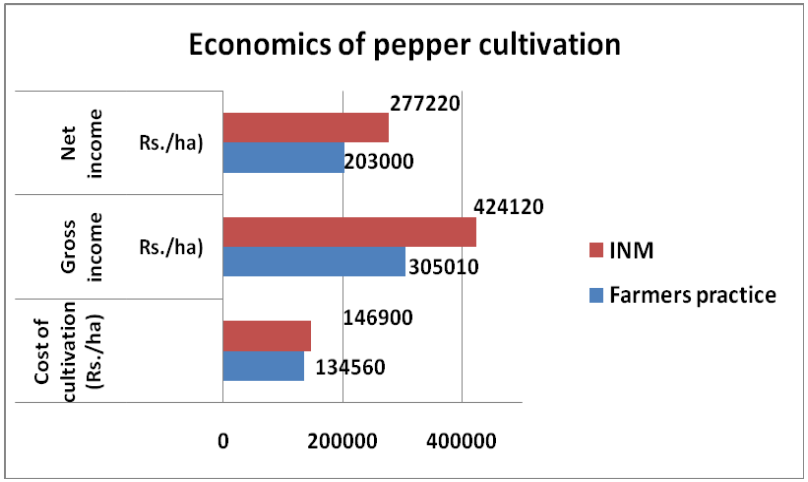


Fig.1. Yield attributes and economics of Black Pepper