Original Research Article

Effect of Poultry Manure, N.P.K Fertilizer and their Combinations on the Growth and Yield of Sweet Pepper

ABSTRACT

The objective of the experiment was to investigate the influence of organic (poultry) manure, inorganic manure (N.P.K) and their combinations on the growth and yield of sweet pepper in the transitional zone of Ghana. The experiment was conducted at the research field of the College of Agriculture Education, University of Education Winneba, Mampong campus in 2017. The experiment was laid out in randomized complete block design (RCBD) which consisted of four treatments with 4 replications. The treatment groups were: Control (no soil amendment), 10 t/ha PM, 300 kg/ha N.P.K, and 5 t/ha PM + 150 kg/ha N.P.K. All the treatments were given fair and equal attention in terms of watering, weeding and disease and pest control. The result showed that 10 t/ha PM recorded (P=.05) the tallest plant height, greater number of leaves and leaf area per plant, days taken for 50% bud appearance and flowering, the highest number of flowers per plant and the minimum days to fruit set, highest number of fruit set minimum days to harvesting with the control been the least in all traits. Similarly, 10 t/ha PM recorded (P=.05) had the highest number of fruits per plant, average fruit weight and fruit yield while the control treatment recorded the least in all traits. This study concludes that the application of poultry manure improves the productivity of sweet pepper. This study recommends that 10 t/ha PM is an ideal for maximum vegetative growth and yield of sweet pepper.

Keywords:Sweet pepper; poultry manure, N.P.K fertilizer; vegetative growth; yield.

1. INTRODUCTION

Capsicum annuum which is commonly called Sweet pepper or Belt pepper is an exotic vegetable crop. It is a member of the Solanacae family [1]. The crop is known to have originated from Tropical America [2]. The fresh, large square fruits have thick walls that surround the seeds. They are picked when green. The leaves are glabrous and lanceolate [3]. The mature fruits of sweet pepper are used more as a vegetable than as a spice. They are used either raw in salads or stuffed with meat or rice and cooked.

Some types are dried and ground to produce a red condiment, and the fruit is rich in vitamin C [4]. According to [4] the cultivation of sweet pepper is confined to the urban centres such as Accra, Tema, Kumasi, Takoradi etc. It is only in recent years that efforts have been made by some newly established agencies to export few quantities to some European countries.

The productivity of Sweet pepper in Ghana is very low and this could be attributed to intensive cultivation on the same piece of land, farmers' inability to buy inorganic fertilizers due to high cost of purchasing them, inappropriate agronomic practices which include poor soil amendment, cultural practices and spacing [1, 5]. Soil fertility regeneration and maintenance appear to be the most serious agronomic challenge to sweet pepper production in Ghana [6]. It is critical in areas devoid of tropical forest vegetation necessary for quicker natural restoration. Furthermore, continuous cultivation of the land has resulted in accelerated soil nutrient depletion, decline

in soil organic matter content, loss of physical structure and reduced crop productivity [2, 4, 5].

Maintaining soil fertility status has been seen as one of the best soil management practices that influence sweet pepper productivity. The best option to maintain soil fertility as well as higher yield is through application of organic and inorganic fertilizer. The objective for the study was to determine the effect of organic (poultry) manure, inorganic manure (N.P.K) and their combinations on the growth and yield of sweet pepper in the transitional zone of Ghana.

2. MATERIAL AND METHODS

2.1 Experimental Site

The field experiment was carried out at the Multipurpose Crop Nursery of the College of Agriculture Education, University of Education, Winneba, Mampong- Ashanti campus located in the forest-savannah transitional zone of Ghana in 2017. Mampong-Ashanti is located 60 km North-East of Kumasi on the Kumasi - Ejura road. Mampong-Ashanti lies in the transitional zone between the Guinea savanna zone of the north and the tropical rain forest of the south of Ghana. The climatic, vegetation and demographic characteristics of Mampong-Ashanti have been described by [7, 8]. FAO classify the soil at the experimental site as Chromic Luvisol[9].

The soil at the experimental site is sandy loam, well drained with thin layer of organic matter with characteristic deep yellowish red colour, friable and free from stones. The pH ranges from 6.5-7.0. It is permeable, and has moderate water holding capacity. Mampong-Ashanti lies between latitude 07^{o} 04' degrees north and longitude 01^{o} 24' degrees west with an altitude of 457 m above sea level.

Maximum and minimum annual temperatures recorded during the study period were 30.6^{o}C and 21.2^{o}C, respectively [10]. Rainfall pattern in the district is bimodal, occurring from April to July (major rainy season) and again August to November (minor rainy season), with about 1224mm per annum. The dry season occurs from December to March. The average relative humidity ranged from 54.5 % and 78.8 % with the highest occurring between September and November. The vegetation is transitional savanna woodland, which guarantees sweet pepper production.

2.2 Experimental Design and Treatments

The Randomized Complete Block Design (RCBD) was used in assigning treatments to plots. There were three (3) different soil amendment groups and the control treatment which were replicated four (4) times. The design was chosen to minimize variation among the blocks in order to avoid bias in case of differences in the fertility level of the soil. The treatment groups were: Control (no soil amendment), 10 t/ha PM, 300 kg/ha N.P.K, and 5 t/ha PM + 150 kg/ha N.P.K.

2.3 Organic Manure Preparation and Analysis

Three weeks old poultry manure was obtained from a deep litter system of housing poultry birds kept under intensive system of management from the animal farm at the College of Agriculture Education, University of Education, Winneba, Mampong Campus. The poultry manure was heaped under shade for two weeks and covered with plantain leaves, supported by sticks to minimize the volatilization of N through Ammonia gas. Samples of the poultry manure were sent to CSIR- Soil Research Institute, Kwadaso-Kumasi to determine the chemical composition of the poultry manure.

2.4 Land Preparation, Manure Application and Planting

The experimental field was cleared with cutlass ploughed, disked and harrowed to

a fine tilth. An area of length 14m and a breadth of 14m was measured and marked out. A total land size of 196 square meters was marked out. A total number of 16 beds were raised. Each bed (plot) measured 4m in length and 2m in breadth making an area of 8.0m^2 with a distance of 1.0m created as pathway between beds. There were four blocks and each had four (4) plots. Well composted poultry manure was incorporated into respective treatment plots two weeks before the transplanting of Sweet pepper plants. Sweet pepper seeds were purchased from KAS Agro-chemicals shop at Mampong-Ashanti. Two nursery beds were raised with a measurement of 4.0m in length and 1.4m in breath giving an area of 5.60m^2 each.

The sweet pepper seeds were drilled to a depth of 0.6-10cm and 17.0cm apart in rows. Germination began after seven days of nursing. Dry palm fronds were used to provide shade over the seedlings to avoid direct sunlight. Watering was done with watering can every other day. Healthy and vigorous growing seedlings were selected 30 days after nursing and transplanted in the field. This was done in the evening to reduce the risk of desiccation and poor establishment after being hardened by increasing watering interval.

2.5 Agronomic Practices

NPK 15:15:15 was applied at full rate of 300 kg/ha as sole treatment and at half rate of 150 kg/ha as a supplement to poultry manure plots. The NPK fertilizer was applied 5 cm away from the plant by side placement two weeks after transplanting the seedlings. Manual weed control was done using cutlasses and hoes. No weedicide was applied to control weeds. The plants were regularly irrigated twice in a day, depending on the weather condition. All plants received the same amount of water.

2.6 Data Collection and Statistical Analysis

2.6.1 Plant sampling and data collection

Data were collected on plant height, plant girth, number of leaves yield parameters. The heights of the five (5) randomly selected experimental plants were taken every two weeks. The measurement was done from the soil level of the stem to the tip of the highest apical bud using a metre rule. The mean height of all the experimental plants on each plot with respect to each treatment was determined to get a representative plant height for the plots.

The girth of each of the five (5) randomly selected experimental plants were measured every two weeks. This was procured by tying a thread (string) round the base of the plant at about 0.5cm from ground level. The length obtained by the thread at the base of the plant was measured on a metre rule. And the average plant girth was calculated for each treatment. All fully mature leaves on the randomly selected experimental plants were counted. The average was calculated for each treatment. Matured fruits were harvested every two weeks. Records of number of fruits per plot and fresh weight of fruit per plot were taken.

2.7 Statistical Analysis

The data collected was analyzed using the one-way analysis of variance (ANOVA) with the aid of GENSTAT Version 11.1 (2008), according to the procedure of [11] and the treatment means were separated by the least significant difference (LSD) to determine which of the treatments has significance difference or not at 5% probability level.

3. RESULTS

3.1 Nutrient Levels of Poultry Manure Used in the Experiment

Poultry manure had the highest levels of nitrogen (N), total phosphorus calcium (Ca) and (P) total magnesium (Mg). Followed by the combination of poultry

manure and N.P.K with the control treatment been the least. The pH for the control plots and the different soil amendment treatments were basic (Table 1).

3.2 Soil Chemical Properties at theExperimental Site

Table 2 shows the soil chemical properties during the growing season, the soil at 0-30 cm was acidic. The general soil fertility status of the experimental sites was low. This finding is similar to earlier report by [7] that most soils in the Ashanti Region of Ghana are characterized by poor nutrient retention due to the dominance of low activity clay and low organic matter content. This observation also agrees to earlier reports by [8] and [9] that sandy loamy soils in the Ashanti Region are low in organic carbon (< 1.5%), total nitrogen (< 0.2 %), exchangeable potassium (< 0.26 cmol(c) /kg) and available phosphorus (< 10 mg/kg) contents. The levels of Al^{3+}, Ca^{2+}, H^{+}, K^{+}, Mg^{2+} and Na^{+} content were generally low according to the rating of [8] and this could be attributed to the low levels of basic cations observed, possibly due to leaching out of the top soil and continuous cropping.

Similarly, the low levels of organic matter, available P, soil organic carbon and total Nitrogen levels (Table 2) were generally low according to the rating of [9] and this could be attributed to continuous cropping without frequent soil amendment. The acidic pH value recorded could be due to the low levels of basic cations observed, possibly due to leaching out of the top soil. The low bulk density recorded could be due to high temperatures prevailing at the experimental sites which resulted in rapid organic carbon decomposition and continuous cropping on the same piece of land.

3.3 Soil Nutrient Levels after Fertilizer Application

From Table 3 the soil pH for treated plots recorded an increase over the control plots. The organic and inorganic manure treated plots and their combination gave higher levels of organic carbon, percentage total N and organic matter content than the control plots (Tables 3). Nutrient contents in post harvest soil significantly varied due to the application of different soil amendment. In general, the soil had improved fertility status due to the various soil amendment applied except the control plots.

The 10 t/ha PM recorded the highest Ca and K levels while the 5 t/ha PM and 150 kg/ha N.P.K recorded the highest Mg (Table 3). The highest level of Al, soil pH and soil bulk density observed among sweet pepper plants amended with 10 ton/ha PM indicates that there was adequate release of nutrients into the soil for plant growth. The application of 10 ton/ha PM, 5 t/ha PM and 150 kg/ha gave an increase in TEB and ECEC levels than the sole NPK and the control treatments (Table 3).

3.4 Vegetative Growth

3.4.1 Plant Height (cm)

There were significant (P=.05) differences observed in plant height across the treatment groups. The results presented in Table 4a shows that the tallest plant height was recorded with sweet pepper plant amended with 10 t/ha PM followed by the application of 5 t/ha PM + 150 kg/ha N.P.K and 300 kg/ha N.P.K while the control treatment recorded the shortest plant height.

3.4.2 Number of Leaves and Leaf area/plant

The highest (P=.05) number of leaves and leaf area per plant were recorded with 10 t/ha PM while the least number of leaves and leaf area per plant were recorded with the control while 5 t/ha PM + 150 kg/ha N.P.K and 300 kg/ha N.P.K recorded the intermediate mean values for both number of leaves and leaf area per plant (Table 4a).

3.4.3 Days to 50% bud appearance and flowering

Minimum (P=.05) days taken for 50% bud appearance was recorded in sweet pepper plants amended with 10 t/ha PM and 5 t/ha PM + 150 kg/ha N.P.K followed by 300 kg/ha N.P.K while maximum number of days was recorded with the control. Similarly, minimum (P=.05) days to 50% flowering were recorded with 10 t/ha PM and 5 t/ha PM + 150 kg/ha N.P.K followed by 300 kg/ha N.P.K while maximum number of days to 50% flowering were recorded with the control while maximum number of days to 50% flowering was recorded with the control (Table 4a).

3.4.4 Number of flowers/plant and days to fruit set

The application of 10 t/ha PM significantly (P=.05) produced the highest number of flowers per plant and the minimum days to fruit set followed by 5 t/ha PM + 150 kg/ha N.P.K and 300 kg/ha N.P.K while the control treatment recorded the least number of flowers per plant and the maximum days to fruit set (Table 4b).

Table 1. Chemical properties of poultry manure used in the experimental field

Property	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	pH
Poultry manure	2.10	1.43	0.72	0.91	1.35	6.81

Table 2. Initial Chemical properties of the experimental field

Soil property	Min	Max	Mean	SD
Chemical properties				
Al^{3+}	0.33	0.50	0.41	0.11
Ca^{2+} (cmol/kg soil)	2.16	2.82	2.49	0.46
H^{+}	0.17	0.17	0.16	0.00
K^{+}	0.30	0.33	0.31	0.02
Mg^{2+}	0.34	0.44	0.39	0.07
Na^{+}	0.002	0.002	0.002	0.00
Organic matter (%)	1.00	1.03	1.01	.02
P (mg/kg soil)	9.58	12.17	10.87	1.82
Soil pH (1:1 H2O)	5.79	5.85	5.82	0.04
Soil organic carbon (%)	0.58	0.60	0.58	0.01
Total N (%)	0.05	0.06	0.05	0.004
Physical properties				
Clay (%)	7.24	8.32	7.78	0.76
Sand (%)	79.40	81.32	80.36	1.35
Silt (%)	10.36	13.36	11.86	2.12
Texture	Sandy loam			
Bulk density (Mg/m3)	1.16	1.33	1.25	0.12

Values are means of duplicate sample analyses. SD = Standard deviation,CV = Coefficient of variation.

Table 3. Soil Chemical Properties after fertilizer application

Soil property	Control (No soil amendment)	10 t/ha PM	300 kg/ha N.P.K	5 t/ha PM + 150 kg/ha N.P.K
Chemical properties				
Al^{3+} (cmol/kg soil)	0.34	0.57	0.48	0.51
Ca^{2+} (cmol/kg soil)	3.61	5.20	4.83	4.78
K^{+} (cmol/kg soil)	0.11	0.64	0.51	0.21
Mg^{2+} (cmol/kg soil)	1.14	2.31	1.78	2.03

Na^+ (cmol/kg soil)	0.18	0.43	0.23	0.31
P (mg/dm^3)	46.3	68.9	66.5	62.5
N (%)	0.08	0.12	0.11	0.09
Soil Ph	5.42	6.85	6.44	6.65
Physical properties				
Organic carbon (%)	0.66	0.99	0.95	0.89
Organic matter (%)	1.67	2.01	1.97	1.81
T.E.B	5.59	7.24	6.52	6.81
E.C.E.C (me/100g)	4.53	6.89	6.72	6.55
Base saturation (%)	69.5	95.4	91.3	93.6
Clay (%)	12.50	8.00	9.00	12.50
Sand (%)	78.00	82.00	81.00	77.50
Silt (%)	22.00	18.00	19.00	22.50
Bulk density (Mg/m3)	1.31	1.51	1.42	1.41

Values are means of four replicates. LSD = Least significant differences of means, CV = Coefficient of variation, T= Treatment, % = Percentage, PM= Poultry Manure, T.E.B= Total Exchangeable Bases, E.C.E.C= Effective Cation Exchange Capacity

Table 4a. Effect of poultry manure and N.PK fertilizer on growth of sweet pepper

Treatment	Plant Height (cm)	No. of leaves/plant	Leaf area/plant	Days to 50% bud appearance	Days to 50% flowering
Control (No soil amendment)	38.7	49.4	41.6	86.8	28.9
10 t/ha PM	57.5	77.2	55.3	75.6	18.4
300 kg/ha N.P.K	40.7	58.8	46.7	82.4	21.4
5 t/ha PM + 150 kg/ha N.P.K	49.3	68.8	54.9	75.2	15.5
LSD (P=0.05)	0.31	1.32	1.46	1.29	1.42
CV (%)	17.3	21.2	18.3	23.4	19.5

LSD = Least significant differences of means, CV = Coefficient of variation, PM= Poultry Manure.

Table 4b. Effect of poultry manure and N.P.K fertilizer on growth of sweet pepper

Treatment	No. of flowers/plant	Days to fruit set	No. of fruit set	Days to harvesting
Control (No soil amendment)	6.37	19.1	2.41	175
10 t/ha PM	9.65	11.8	4.95	127
300 kg/ha N.P.K	8.53	11.9	3.72	155
5 t/ha PM + 150 kg/ha N.P.K	9.26	12.5	4.52	134
LSD (P=0.05)	1.33	1.28	1.41	1.27
CV (%)	10.2	15.5	21.8	23.5

LSD = Least significant differences of means, CV = Coefficient of variation, PM= Poultry Manure.

Table 5. Effect of poultry manure and N.PK fertilizer on yield of sweet pepper

Treatment	Number of fruits/plant	Av. Fruit Weight (g/fruit)	Fruit yield/plant (g)	Fruit yield (ton/ha)
Control (No soil amendment)	2.18	50.5	106	62.5
10 t/ha PM	4.18	98.7	351	107
300 kg/ha N.P.K	2.87	84.9	209	92.7
5 t/ha PM + 150 kg/ha N.P.K	3.40	92.6	332	98.5
LSD (P=0.05)	1.09	1.36	16.4	11.8

CV (%)	13.6	19.2	25.6	22.4

LSD = Least significant differences of means, CV = Coefficient of variation, PM= Poultry Manure, Av = Average.

3.4.5 Number of fruit set and days to harvesting

The application of 10 t/ha PM significantly (P=.05) produced the highest number of fruit set followed by 5 t/ha PM + 150 kg/ha N.P.K and 300 kg/ha N.P.K while the control treatment recorded the least number of number of fruit set. Maximum (P=.05) days to harvesting were recorded with the control treatment followed by 300 kg/ha N.P.K while minimum days were recorded with the application of 10 t/ha PM and 5 t/ha PM + 150 kg/ha N.P.K (Table 4b).

3.5 Yield and Yield Components

Number of fruits per plant, average fruit weight and fruit yield were significantly (P=.05) higher with 10 t/ha PM followed by 5 t/ha PM + 150 kg/ha N.P.K and 300 kg/ha N.P.K while the control treatment recorded the least in all traits (Table 5).

4. DISCUSSION

The tallest plant height, increase in the number of leaves per plant and leaf area per plant as well as the steady growth in response to 10 t/ha poultry manure may be attributed to the release of macro and micro nutrients by poultry manure during the course of microbial decomposition. This could be further explained that poultry manure contains Calcium (Ca), Magnesium (Mg), Zinc (Zn) and Manganese (Mn) in higher levels which improved the growth performance of *Capsicum*. Again poultry manure is a good source of organic matter which improved the physic~~o~~al-chemical properties of soil and there by resulted in better plant height, increased in the number of leaves per plant and leaf area per plant of *Capsicum*. The highest number of leaves produced might be due to the fact that application of 10 t/ha poultry manure provided adequate Nitrogen which is associated with high photosynthetic activity and vigorous vegetative growth. Similar results were reported by [4, 12, 13] who indicated that there was higher and rapid release of nutrients from poultry manure amended soil as compared to the other treatment groups.

The decreased in days to 50% bud appearance as a result of the application of 10 t/ha poultry manure may be due to the fact that poultry manure is a good source of organic matter, which improved the physic~~o~~al- chemical properties of soil and thereby resulted in earliness in bud appearance and days to flowering. The earliness in flowering could be attributed to some plant growth promoters such as auxins and gibberellic acid in poultry manure which induces flowering, enhancement of vegetative growth and storing sufficient reserved food materials for differentiation of buds into flower buds. Similar results were obtained by [12, 14] who reported that sweet pepper plant treated with poultry manure at different rates reached maturity earlier in terms of bud appearance and days to flowering as compared to other soil amendment groups.

The significant improvement in number of flowers per plant and days to fruit set in the application of 10 t/ha PM may be due to translocation of nutrients to the aerial parts of the plant due to adequate supply of nutrients. This could also be further explained that poultry manure contains Calcium (Ca), Magnesium (Mg), Zinc (Zn) and Manganese (Mn) in higher levels which influenced higher production of flowers in *Capsicum* and reduced days to fruit set. The ~~Solubilisation~~ Solubilty effect of plant nutrients by addition of poultry manure leads to increase uptake of nitrogen, phosphorous and potassium and resulted in maximum number of flowers per plant and reduced the days to fruit set in *Capsicum*. These results are in line

with the observation made by [6, 13] who reported that the application of poultry manure at 10 t/ha increased the nutrient statues of the amended soil thereby increasing the number of flowers per plant and reduced the days to fruit set in *Capsicum*.

Maximum number of fruit set observed in this study may be due to the application of 10 t/ha poultry manure leading to increased uptake of essential plant nutrients. Minimum number of days taken to harvesting observed in the application of 10 t/ha poultry manure may be due to the improved physicophysical-chemical properties of the amended soil. The application of poultry manure to the soil enhanced microbial activity, which significantly improved the availability of macro and micro nutrients to the plants. Similar findings were reported by [12, 14, 15] who observed maximum number of fruit set with minimum number of days to harvesting among soil amendment groups as compared to the control.

The increased in number of fruits per plant, average fruit weight and fruit yield with 10 t/ha PM could be due to the production of more number of flowers, higher percentage of fruit set and reduced shedding of flowers and fruits which resulted in increased fruits. This could also be attributed to a higher C/N ratio and increased plant metabolism. This is in line with the findings of [15, 16, 17] who reported a significant increase in number of fruits per plant, average fruit weight and fruit yield due to poultry manure soil amendment.

5. CONCLUSION

This study concludes that the vegetative growth of sweet pepper recorded marked differences in the different amended plots as compared to the control plots. The application of 10 t/ha poultry manure and the 5 t/ha PM + 150 kg/ha N.P.K had improved growth performance with higher productivity in terms of number of fruits per plant, average fruit weight and fruit yield.

REFERENCES

1. Tripathy P, Maity TK. Evaluation of Kharif Okra hybrids under reduced level of chemical fertilizers. Orissa Journal of Horticulture, 2011; 36(1): 1-7.
2. Lampkin NH. Organic farming. *In:* S. Padel (ed.). Soil sickness and soil fertility. 2000. *Cab Publisher, Wallingford*, USA.
3. Norton RM, Howie P, Walker C. Soil test values and nutrient balances from a long term fertilizer experiment. 2012. *16th Australian Agronomy Conference*.
4. Adhikari P, Khanal A, Subedi R. Effect of different sources of organic manure and chemical fertilizers on growth and yield of sweet pepper. Advances in Plants and Agriculture Research. 2016; Vol. 3(5): 00111.
5. Gobinath KA, Supradip S, Banshi LM, Kundu S, Gupta HS. Effect of organic manures and integrated nutrient management on yield potential of bell pepper (Capsicum annuum L.) varieties and on soil properties. Journal of Agronomy and Soil Science. 2011; 54:127-137.
6. Kumar M, Baishya LK, Ghosh DC, Ghosh M, Gupta VK, Verma MR. Effect of Organic manures, Chemical fertilizers and Biofertilizers on Growth and Productivity of Rainfed Potato in the Eastern Himalayas. Journal of Plant Nutrition. 2013; 36:1065-1082.
7. Adu SV. Soils of the Nasia basin. 1995; Memoir No. 6. Soil Research Institute. Kumasi.
8. Hazelton P, Murphy B. Interpreting Soil Test Results: What do all the numbers mean? 2nd Edition. CSIRO Publishing, Australia. 2007.

9. Asiamah RD. Soils Suitability of Ashanti Region. Soil Research Institute(S.R.I). Council for Scientific and Industrial Research, Kwadaso, Ghana, 1998. Report No 193.Pp. 21.
10. Meteorological Services Department (MSD). *Annual Reports*. Mampong Municipal Assembly, Mampong-Ashanti, Ashanti Region, Ghana. 2017.
11. Steel GD, Torrie JH. Principles and Procedures of Statistics. McGraw Hill Co. Inc. New York.1980.
12. Pariari A, Khan S. Integrated nutrient management of chilli (Capsicum annuum L.) in Gangetic alluvial plains. Journal of Crop and Weed. 2013; 9(2):128-130.
13. Shiva KN, Srinivasan V, Zachariah TJ, Leela NK. Integrated nutrient management on growth, yield and quality of paprika alike chillies (Capsicum annuum L.) Journal of Spices and Aromatic Crops. 2015; Vol.24 (2) 92-97.
14. Leela PR, K. Balaswamy A, Ramachandra RC, Masthan S. Evaluation of Integrated Nutrient management Practices on Growth, Yield and Economics of Green chilli cv. PusaJwala (Capsicum annuum L.). International Journal of Bio-resource and Stress Management. 2015; 6 (1):076-080.
15. Tajungsola J, Vijay BR, Prasad VM, Carol L. Effect of Organic Manures and Chemical Fertilizers on Growth and Yield of Sweet Pepper (Capsicum annuum L.) Hybrid IndamBharath in Shade Net Condition. International Journal of Current Microbiology and Applied Science. 2017; 6(8): 1010-1019. doi: https://doi.org/10.20546/ijcmas.2017.608.125.
16. Sree KMR, Satyakeerthi MRP, Kumari MV. Studies on the use of high grade rock phosphate as direct fertilizer along with integrated plant nutrient system (IPNS) components. Phosphate rich organic manure an alternate to phosphatic fertilizers. 2004; 70-87.
17. Rasoli S, Forghani A. Effect of organic manure on micronutrient availability in different soils. 2006. *18th World Congress of Soil Science, Philadelphia, Pennyslvania*.