

Inorganic Fertilzer, Vermicompost and Water Quality Effect on Vegetable Farming Along The River Banks.

Beetseh C I Chukwu, J C
Department of Chemistry University of Agriculture Makurdi

Abstract
Inorganic fertilizer , vermicompost and water are a usual application on vegetable farming along river banks in order to boost its production , issues however arising of interest from these three are highlighted in this work on river Benue river bank vegetable farming . Vermicompost a heterogeneous mixture of decomposing materials in a dust bin (vegetables , Tea bags , grains , bread, crackers , cereals , eggshells , Leaves and grass clippings) composting using various worms developed within it from flies showed that in 30 days at 20% concentration of vermicompost plot of Red pepper (Capsicum annuum) a plant height of average 16.6cm was recorded while that of chemical fertilizer showed the same plant a height of 14.8cm . Control plot (without any application) showed 10.9cm height . At 60 days the inorganic fertilizer applied at 20% dose showed 29.2cm plant height and in vermicompost applied plots at the same concentration dose, 33.4cm of plant height, was the result. Applying these products on vegetable farms using water along the river banks of River Benue directly and indirectly brings to attention the uncontrollable habit of settlers along river banks especially in the refuse discharge and defeacation which compromises the water and the quality of products of the farms . Work carried out in Delhi University in 2009 showed that the amount of fecal matter in river water increased exponentially as Central Pollution Control Board CPCB came out with its findings. The amount of Fecal coliform (FC) – bacteria (anaerobic , nonsporulating, rod-shaped bacteria that produce acid and gas from the fermentation of lactose sugar: e.g., Escherichia coli, Enterobacter aerogenes, and Klebsiella pneumoniae) available in human and animal feaces – has grown by as much as 30 times as compared to CPCB values. Vegetables grown on Yamuna bed in east and south Delhi are already known to have high FC . The work done on river Benue at intake in the greater water works project showed the value of coliform bacteria as high as 1800 Beetseh and Adulugba (2013) . Many millions of microorganisms (though most are harmless in the human intestinal tract) are likely to carry pathogenic microbes. Coliforms are used as indicators of sewage pollution; a high coliform count usually indicates recent sewage pollution. implicating the vegetable production on the river bank which on consumption can bring one down with severe intestinal problems like blood infections, stomach upsets and kidney dysfunction .The application of modern farming system innovations in the study area by the farmers will be difficult since majority of them are illiterates Dam, P. D. (2012) especially in the use of proper toilet systems . According to the same Delhi University 2009 report mentioned earlier the probable partial solution is to allow for the growth of water hyacinth, which absorbs contaminants and vegetables to be repeatedly washed and cooked. Raw vegetables on these river banks should be avoided .
Keywords Vegetables , Fertilizer , River bank Vermicompost and Farming .

Introduction
Modern crop farming varies widely in its scope, ranging from intensively managed small plots to commercial farms covering thousands of acres. Successful crop farmers must be expert at selecting the kinds and varieties of plants that are adapted to their soils and climate. They must be skilled in preparing soil and in planting, growing, protecting, harvesting, and storing crops. They must be able to control weeds, insects, and diseases, and they need good marketing skills to gain reasonable returns from their crops . Water is as vital for plants as it is for other organisms. The pressure of water within the plant cells helps the plant’s leaves to remain firm. Water also is essential for most of the plant’s biochemical reactions. In addition, water stores essential dissolved nutrients. How often plants need water depends on how hot, dry, and windy the climate is, how well the plant tolerates dry conditions, and how deep the roots go into the soil. Plants can be watered at any time of day. However, to avoid plant diseases that thrive in cool, moist conditions and to reduce water lost through evaporation, gardeners water in the early morning, when the air is cool and still, but the sun will soon dry the leaves. The best method for watering plants is to apply the water directly to the soil, rather than over the tops of the plants. The water should be applied at a rate no faster than it can percolate into the soil so that the excess will not run off and be wasted. This technique reduces water lost through evaporation and keeps leaves dry, which discourages diseases. A few tools for watering the soil efficiently include hoses with tiny holes all along their surface, called soaker hoses; plastic tubes with tiny holes punched in them at intervals for drip irrigation; and plastic jugs with small holes punched in the bottom, filled with water, and set beside a plant. Watering large, densely planted areas, such as a lawn, requires a sprinkler. Evaporation of water from the soil can be minimized by covering the soil with a protective layer known as mulch. Mulch acts as a barrier that slows evaporation by

reducing the amount of air and heat that reaches the soil surface. Materials that can be used as mulch include leaves, bark chips, grass clippings, and cardboard. Records of P D Dam (2012) on dry season vegetable farming in Benue State has described a small-scale vegetable irrigation farming as a system usually practiced along river banks (floodplains or Fadama land) by farmers who take responsibility for the investment and management of their farms. In Nigeria dry season vegetable farming has its origin in thenorthern region. Vegetable farming is more common, popular and lucrative in towns on the Jos Plateau and along Katsina Ala and Benue rivers . It is a major economic activity during the dry season involving many youths (Iorkua, Ikyernum and Kereku, 2004, Adepoju and Dung, 1999).Other areas of irrigation farming in Nigeria include Lake Chad, Yobe River, Kanji Dam, Sokoto River Basin. Adepetu (1989) and government effort to encourage dry season farming in the country led to the construction of large Dams such as Kiri Dam (former Gongola State), Tiga Dam (Kano State), Bakolori Dam (Sokoto State) and Dadinkowa Dam (Gombe State). According to records of Britannica Encyclopedia 2010 vegetables are usually referred to the fresh edible portion of a herbaceous plant—roots, stems, leaves, flowers, or fruit usually classified on the basis of the part used for food. The root vegetables include beets, carrots, radishes, and turnips. Stem vegetables include asparagus and kohlrabi. Among the edible tubers, or underground stems, are potatoes. The leaf and leafstalk vegetables include brussels sprouts, cabbage, celery, lettuce, rhubarb, and spinach. Among the bulb vegetables are garlic, leeks, and onions. The head, or flower, vegetables include artichokes, broccoli, and cauliflower. The fruits commonly considered vegetables by virtue of their use include beans, cucumbers, eggplant, okra, peas, sweet corn, squash, peppers, and tomatoes. Modern vegetable farming ranges from small-scale production for local sale to vast commercial operations utilizing the latest advances in automation and technology. Most vegetables are planted by seeding in the fields where they are to be grown, but occasionally they are germinated in a nursery or greenhouse and transplanted as seedlings to the field. During the growing season herbicides, pesticides, and fungicides are commonly used to inhibit damage by weeds, insects, and diseases, respectively. Harvesting operations are usually mechanized in well-developed nations, but the practice of harvesting by hand is still employed in some areas or is used in conjunction with machine operations. Another concern of the vegetable farmer is postharvest storage, which may require refrigerated facilities. Home gardening provides vegetables exclusively for family use. About one-fourth of an acre (one-tenth of a hectare) of land is required to supply a family of six. The most suitable vegetables are those producing a large yield per unit of area. Bean, cabbage, carrot, leek, lettuce, onion, parsley, pea, pepper, radish, spinach, and tomato are desirable home garden crops.

1 . **VEGETABLES**

Figure 1 Bunches of carrots (Daucus carota). Courtesy Dan Burton/Nature Picture Library 2010

Most fresh vegetables have a water content in excess of 70 percent, with only about 3.5 percent protein and less than 1 percent fat. Vegetables, however, are good sources of minerals, especially calcium and iron, and vitamins, principally A and C.

Figure 2 Unshelled peas. Courtesy William Whitehurst/Corbis 2010

Market gardening produces assorted vegetables for a local market. The development of good roads and of motor trucks has rapidly extended available markets; the market gardener, no longer forced to confine his operations to his local market, often is able to specialize in the production of a few, rather than an assortment, of vegetables; a transformation that provides the basis for a distinction between market and truck gardening in the mid-20th century. Truck gardens produce specific vegetables in relatively large quantities for distant markets. In the method known as forcing, vegetables are produced out of their normal season of outdoor production under forcing structures that admit light and induce favourable environmental conditions for plant growth. Greenhouses, cold frames, dry season , irrigation and hotbeds are common structures used. Hydroponics, sometimes called soilless culture, allows the grower to practice automatic watering and fertilizing, thus reducing the cost of labour. To successfully compete with other fresh market producers, greenhouse vegetable growers must either produce crops when the outdoor supply is limited or produce quality products commanding premium prices

2.0 **FERTILIZERS**

Fertilizers are organic or inorganic substances that are added to the soil to improve the fertility of the soil, they contain essential nutrients needed by plant at a given rate. Fertilizers are supplied to the soil in a form that it will be convenient for the plant to absorb them from the soil. Inorganic fertilizers are fertilizers that are synthetic, that are artificial form of plant nutrients supply. (Ngeze, 1998). The growing plant requires nutrients such as nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), sodium (Na) and sulphur (S) for soil fertility maintenance and crop production. These nutrients have specialized functions and should be supplied to plant at the right time and the right quantity According to the study of Firoz, (2009) Nitrogen and Phosphorus are major nutrients required by okra for proper growth similarly Sultana (2000) found highest plant height with the application of same dose of phosphorus. Compost contains variable amounts of N, P and K and is a valuable source of plant nutrients. Among various sources of organic matter, vermicompost have been recognized as having considerable potential as soil amendments recently, there is an increasing interest in the potential of vermicompost, which is a product of a non-thermophilic biodegradation of organic materials through interactions between earthworms and microorganisms, as plant growth media and soil amendment. Chicken litter, which consists of chicken manure mixed with sawdust, is an organic fertilizer that has been shown to better condition soil for harvest than synthesized fertilizer.According to Wikipedia (Fertilizer) 2013 researchers at the Agricultural Research Service (ARS) studied the effects of using chicken litter, an organic fertilizer, versus synthetic fertilizers on cotton fields, and found that fields fertilized with chicken litter had a 12% increase in cotton yields over fields fertilized with synthetic fertilizer. In addition to higher yields, researchers valued commercially sold chicken litter at a $17/ton premium (to a total valuation of $78/ton) over the traditional valuations of $61/ton due to value added as a soil conditioner. Other ARS studies have found that algae used to capture nitrogen and phosphorus runoff from agricultural fields can not only prevent water contamination of these nutrients, but also can be used as an organic fertilizer. ARS scientists originally developed the "algal turf scrubber" to reduce nutrient runoff and increase quality of water flowing into streams, rivers, and lakes. They found that this nutrient-rich algae, once dried, can be applied to cucumber and corn seedlings and result in growth comparable to that seen using synthetic fertilizers. Cost of inorganic fertilizer is very high and sometimes it is not available in the market for which the farmers fail to apply the inorganic fertilizers to the crops in time. Organic manure is easily available to the farmers and its cost is low compared to that of inorganic fertilizers. Application of vermicompost produced by biodegradable waste could be one of the most economical and attractive methods of solving the problems like waste disposal and the requirement to increase the organic matter content of soil.

3.0 MATERIALS AND METHODOLOGY

3.1 Substrates

Urea, NPK as chemical fertilizer was purchased from the Ministry of Agriculture Makurdi. Soil analysis was done to know the lacking nutrients. Vermicompost was prepared from locally available municipal biodegradable waste. Analysis was done in triplicate (n=3) to know the actual composition of macro and micro nutrients of soil , the pH was neutral and 35.70C temperature.

Urea was selected as a chemical fertilizer for the study of Capsicum annum crops.

Figure 3 Red pepper (Capsicum annuum) courtesy G.R. Roberts 2010

NPK content in vermin-compost produced was in the optimum range required for plant growth, pH of compost was alkaline suitable for plant growth and acting as growth enhancer. Vermicompost at concentrations of 0, 5, 10, 15 and 20% was applied in the field. Nearly about 20 seeds were planted per plot; watering was done at alternate day on each plot. Monitoring was done at 15 days interval period. Plant height, number of leaves, number of buds etc. were measured at 15, 30, 45, and 60 day's interval period. On 60th day all Capsicum annum plant were uprooted to study the fresh wt. and dry wt. biomass. A comparative data was prepared between each level fertilizer concentration on which plants were grown.

3,2 Determination of Total Coli-form Bacteria

10ml of mac conkey broth was filled in 15 bottles using sterile syringe. The inverted Durham tubes were inserted in each of the bottles and the autoclaved for 15minutes at 121^{o}C. the bottle were then removed and placed in a sterile environment . 10ml of the water samples was inoculated in the first five bottles . 1ml of water was inoculated in the second five bottles while 0.1ml of water was inoculated into the last five bottles. The bottles were kept in an incubator and observed at the end of 24 and 48hours for presumptive and confirmatory test respectively . The number of positive bottles indicated by colour and gas formation in each of the rolls were recorded and compared with the bacterial load in a Mac conkey table. This procedure was repeated for all the water samples (ODNWRI, 1997),

3.3 Determination of Dissolved Oxygen

The dissolved oxygen meter (model 9071 made by the HACH company) was used. The meter was switched on and the probe immerge into distilled water to rinse and adjust the value to zero reading. The probe was then immerged into the water samples and the reading was recorded. The procedure was repeated for all the water samples.

4.0 RESULTS

Table 4.1 Growth parameters of Capsicum annum after application of Urea

S/N	Observation after 15 Days	0% (Control) (Avg±SD)	05% (Avg±SD)	10% (avg ±SD)	15% (Avg ± SD)	20% (Avg ±SD)
1.	Height (cm)	4.6 ± 0.3	4.9 ± 0.1	5.6 ± 0.5	6.9 ±0.3	8.4 ± 0.1
2.	No. of leaves	2.9± 0.1	3.1 ± 0.3	3.8±0.2	4.8±0.6	5.1±0.4
3.	No of buds	0.9±0.2	1.1±0.1	1.9 ±0.5	2.6 ± 0.4	3.8 ± 0.1

S/N	Observation After 30 Days	0% (Control) (Avg±SD)	05% (Avg±SD)	10% (avg ±SD)	15% (Avg ± SD)	20% (Avg ±SD)
1.	Height (cm)	10.9 ± 0.3	12.2 ± 0.4	13.8± 0.6	14.2 ±0.1	14.8 ± 0.4
2.	No. of leaves	5.2± 0.1	7.2 ± 0.1	8.5±0.3	9.1±0.1	9.6±0.2
3.	No of buds	3.3±0.2	13.5±0.1	3.9 ±0.4	4.3 ± 0.2	5.9 ± 0.3

S/N	Observation After 45 Days	0% (Control) (Avg±SD)	05% (Avg±SD)	10% (avg ±SD)	15% (Avg ± SD)	20% (Avg ±SD)
1.	Height (cm)	23.5 ± 0.7	26.0 ± 0.1	27.1 ± 0.3	28.2±0.1	29.2 ± 0.5
2.	No. of leaves	9.4± 0.3	10.3 ± 0.8	11.2±0.1	12.9±0.3	13.9±0.6
3.	No of buds	4.2±0.2	4.5±0.6	4.8±0.1	5.2 ± 0.5	6.7 ± 0.1

S/N	Observation After 60 Days	0% (Control) (Avg±SD)	05% (Avg±SD)	10% (avg ±SD)	15% (Avg ± SD)	20% (Avg ±SD)
1.	Height (cm)	31.2 ± 0.5	32.9 ± 0.2	33.5 ± 0.1	34.4 ±0.7	35.1 ± 0.9
2.	No. of leaves	10.3± 0.1	13.5 ± 0.3	15.1±0.6	17.4±0.1	18.1±0.1
3.	No of buds	6.9±0.9	7.2±0.1	7.6 ±0.3	27.9± 0.7	8.2 ± 0.2
4.	No of fruits	7.3±0.3	7.9±0.1	8.5 ±0.1	8.9± 0.2	9.5± 0.1
5.	Fresh wt. (g)	17.6±0.3	18.1±0.5	19.4 ±0.1	22.1± 0.2	24.3 ± 0.1
6.	Dry wt. (g)	5.32±0.1	6.11±0.6	7.12 ±0.4	09.13± 0.6	10.31± 0.3

Table 4.2 Growth parameter of Capsicum annum after application of vermin-compost at various Doses (n=3)

S/N	Observation After 15 Days	0% (Control) (Avg±SD)	05% (Avg±SD)	10% (avg ±SD)	15% (Avg ± SD)	20% (Avg ±SD)
1.	Height (cm)	4.6 ± 0.3	6.9 ± 0.8	7.6± 0.3	8.9±0.1	9.5± 0.5
2.	No. of leaves	2.9± 0.1	3.6 ± 0.2	4.5±0.1	5.6±0.7	5.9±0.1
3.	No of buds	0.9±0.2	2.1±0.5	2.7±0.6	3.6± 0.2	4.5± 0.6

S/N	Observation After 30 Days	0% (Control) (Avg±SD)	05% (Avg±SD)	10% (avg ±SD)	15% (Avg ± SD)	20% (Avg ±SD)
1.	Height (cm)	10.9 ± 0.3	13.2± 0.4	14.8± 0.1	15.4±0.9	16.6± 0.1
2.	No. of leaves	5.2± 0.4	8.4 ± 0.1	9.1±0.8	9.6±0.2	10-.6±0.4
3.	No of buds	3.3±0.2	5.9±0.2	6.1±0.5	6.8 ± 0.01	7.5± 0.6

S/N	Observation After 45 Days	0% (Control) (Avg±SD)	05% (Avg±SD)	10% (avg ±SD)	15% (Avg ± SD)	20% (Avg ±SD)
1.	Height (cm)	23.5 ± 0.7	28.0 ± 0.5	30.1± 0.6	32.2±0.1	33.4 ± 0.2
2.	No. of leaves	9.4± 0.3	12.9 ± 0.1	13.6±0.2	144±0.1	15.5±0.6
3.	No of buds	4.2±0.2	7.9±0.9	8.1±0.1	8.6± 0.8	9.2 ± 0.3

S/N	Observation After 60 Days	0% (Control) (Avg±SD)	05% (Avg±SD)	10% (avg ±SD)	15% (Avg ± SD)	20% (Avg ±SD)
1.	Height (cm)	31.2 ± 0.5	36.4± 0.6	37.5± 0.3	39.4±0.1	40.7± 0.5
2.	No. of leaves	10.3± 0.1	16.9± 0.1	17.8±0.5	18.3±0.4	19.8±0.2
3.	No of buds	6.9±0.9	8.1±0.2	8.4±0.5	9.4± 0.3	10.3± 0.1
4.	No of fruits	7.3±0.3	9.3±0.5	10.4 ±0.1	9.4± 0.3	12.9± 0.7
5.	Fresh wt. (g)	17.6±0.6	23.9±0.1	24.8±0.3	27.1± 0.6	27.9± 0.4
6.	Dry wt. (g)	5.32±0.3	8.65±0.7	9.21 ±0.2	13.05± 0.1	13.38± 0.2

4.3 Results of dissolved oxygen and fecal count- bacterial load of river Benue at intake and after treatment
A→ Raw water source B→ Treated water from old water works C→ Treated water from new water works

	A1	A2	A3	AX	B1	B2	B3	BX	C1	C2	C3	CX
DO_2(S)	4.0	4.0	4.2	4.06	5.2	5.2	5.1	5.16	5.5	5.4	5.4	5.4
Bacterial	1800	1800	1800	25133.3	1	2	0	1	0	0	0	0

5. 0 DISCUSSIONS

In Vermicompost plot at 20% concentration, on 15th day, plant height was 9.5cm , the leaf number and buds of the plants were more that of chemical fertilizer. On 30th day at 20% concentration of vermicompost height of plant was 16.6cm and that of chemical fertilizer was 14.8cm respectively. The control plot showed 10.9cm height . On 30th day chemical fertilizer and vermicompost plants recorded 29.2cm plant height, 13.9 number. of leaves and 6.7 number of buds and 33.4cm of plant height, 15.5 number of leaves and 9.2 number of leaves and 9.2 number of buds respectively .This pattern has shown clearly over time and is consistent and yet the bacterial load of 1800 is of concern and will be discussed in the conclusion chapter.

6 .0 CONCLUSION .

Among various sources of organic matter, vermicompost have been recognized as having considerable potential as soil amendments . Cost of inorganic fertilizer is very high and sometimes it is not available vermicompost at 15% and 20% concentration dose showed highest result for plant growth parameters compared to chemical fertilizer and control plots. 20% vermicompost is beneficial for plant growth and is economically realizable . When applied at appropriate doses acts as help in soil nutrient restoration for the production of vegetables . The presence of oxygen in water to the value of 4mg/l as shown above makes it useful for plant growth , but the fecal count of 1800 in the same water draws attention on the crops grown in the same vicinity . Taking raw vegetables like garden eggs , carrots, onions and pepper normally eaten as spices can pose possible danger.

7.0 RECOMMENDATIONS

Vegetable farming, compared with other types, requires substantial skills and luck to be successful. Growers must be adept at producing high-quality, attractive vegetables that the public will want to buy. They must be knowledgeable about soil preparation, planting and growing crops, weed and pest control, and water management. They must harvest and handle their products carefully to maintain quality, and they must develop and follow well-planned sales strategies. Mistakes, oversights, poor weather, or bad luck can render a vegetable crop unsightly and unsalable or reduce yields below profitable levels. From the results obtained, compost manure is hereby recommended for the production of vegetables due to their pronounced effects on the growth and yield of vegetables. Toilet facilities and general residential areas to be cited away from cultivation points to avoid contamination.

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