

The effect of soil type and nutrient management on growth of plants.

Dr.Y. G. Thakre,

Assistant professor, Department of Home Science (Faculty of Chemistry), Yeshwant Mahavidyalaya, Wardha, Pin: 442001 Maharashtra

Abstract: Productivity of red and black soil of Wardha region was determined by comparing the plant height, number of leaves, fresh weight, dry weight and leaf area of green gram and spinach plant grown in each soil. Growth measurement of green gram and spinach plant grown in red soil, black soil and red soil with nutrients carried out up to 30 days after germination of seeds of respective plants. The study revealed that growth parameters show variations in red and black soil after applications of nutrients.

Keywords: Nutrients, Growth parameters, Productivity, Germination

Introduction:

Various types of soils are found in Wardha region. These are black soils, red or lateritic soils, mixed red and black soils and yellow soils. Black soils are characterized by their high clay content with high cation exchange capacity and are potentially productive for most of the crops. Red or lateritic soils are devoid of calcium carbonate and are slightly acidic. Mixed red and black soils, red loam, red and yellow soils are less fertile as compared to black soils. The low productivity of red soil is a serious problem in Wardha region. The major reason behind this might be inadequate nutrition, improper selection of soil-site condition, scarcity of water and management practices. Soil serves as a medium for plant growth for providing physical support, water, essential nutrients and oxygen. The suitability of soil sustaining plant growth and biological activity is function of physical properties (porosity, water holding capacity, texture) and chemical properties (nutrient supplying ability, pH, salt content etc.) [1].

In today's overcrowded world, the challenge to food and cloth for the increasing population of developing countries is challenging task. Yields have to be increased from existing land areas, adding fertility to the soils to satisfy the demands of higher yielding crop is essential. Soil varies greatly in their capacity to grow crops without fertilizers, even the richest soils experience declining yields without any inventions. In real meaning, soil is not always a perfect medium for growing plants [2].

Red soil is heavily leached and consists of considerable concentration of iron oxide similar to lateritic soil in India. The color of this soil is red due to presence of more amounts of iron oxide and Fe mineral present in the soil. Hematite containing soils have mostly hues between 5 YR and 10 YR, whereas goethite containing soils with no hematite have hues between 7.5 YR and 2.5 YR [3].

The resources should be managed in a suitable manner so that the changes proposed to meet the needs of development are brought out without diminishing the potential for their future use (Kanwar1994). Sustainable management of natural resources is possible only after characterization and identification of constraint limiting crop production [4].

Soil is a dynamic natural body developed as a result of pathogenic process through weathering of rocks consisting of mineral and organic constituents, possessing definite chemical, physical, mineralogical and biological properties having variable depth over the surface of the earth, and providing a medium for plant growth [5]. The physico-chemical properties of soil play an important role in determining the retention and availability of nutrients in soils. The nutrient supply in soils depends on the level of organic matter. Degree of microbial activity, changes in P^H , types and amount of clay and status of soil moisture [6].

The importance of soil fertility and plant nutrition to the health and survival of all life cannot be overstated. Understanding of the diversity distribution, characteristics and process of soil is important for agriculture development and productivity of agricultural system [7].

Red soil is moderately alkaline to acidic in nature .pH of red soil ranges from 5.2 to6.8. Black soils have high Ph of when may be due to presence of high exchangeable cations on the exchange complex and may be due to presence of high exchange complex and may be due to calcareousness. From this we can conclude that pH is mainly dependent on exchangeable cations and calcium carbonate (Kaushalet.al.1986) which in turn is controlled by topography and physiographic position [8]

Maximum water holding capacity of red and black soils of Wardha region shows less variation due to macro pores and structure of both soils¹⁶.Black soils show water holding capacity due to high percentage of clay and the smectitic clay minerals that have large surface area to retain higher amount of water at high suction. Red soil has relatively low maximum water holding capacity as compared to black soils which could be attributed to the amount of clay content and minerals [9]

Man is dependent on soil because he obtains all the basic necessities of life like food, fiber, shelter from it, but good soils are also dependent on human civilization. Due to the intimate relationship of man's prosperity with soil, it is very essential that unwise exploitation and misuse of soils be avoided. The knowledge of the soils in respect of its origin and formation, nature and properties and distribution becomes imperative in this connection. Such information's are not only useful in agriculture but are equally important for foresters, geologists and engineers for land use planning and soil management [10].

Methods and Material:

Soil sampling

Red and black soil samples sample from different sites of Wardha regions have been collected. After that the soil samples were dried at room temperature in shade and stored in bags with proper labeling. After soil processing and physico- chemical analysis. The physico-chemical characteristics of three soils were analyzed by standard method [11, 12].All soil samples have been filled in different pot for measurement of growth parameters.30 pots filled with black soils, 30 pots filled with red soil and 30 pots filled with red soils with nutrients has prepared to sown the seeds of selected plants in each pots to study the growth of the plants.

Selection of plants for study

Two plants such as Green gram and spinach were selected to study growth parameters. Above plants are grown as mixed, inter crop or in rotation. Pot culture experiment was conducted for period of 30 for spinach and green gram plants .5-6 kg of black, red and red soil with nutrients free from pebbles, sand stone has filled in each 30 pots separately .Each type of soil collected for measurement of plant growth was labeled as sample no .1-30 .seeds of selected plants were sown in all 30 pots and note down the growth parameters such as Plant height, Number of leaves, Fresh weight, dry weight and Leaf area of green gram and spinach. Nutrients that was applied in red soil is in the form of NPK.

Result:

Table 1. Growth measurement of Green gram plants after 30 days

Sample No.	Plant height(cm)			No. of leaves			Fresh weight(g)			Dry weight(g)			Leaf area(cm ²)		
	B	R	R+N	B	R	R+N	B	R	R+N	B	R	R+N	B	R	R+N
1	25.0	21.8	24.5	10	8	9	21.5	16.9	21.0	3.0	1.9	2.6	20.0	15.0	18.0
2	25.5	20.0	24.6	11	8	10	20.0	16.5	19.8	2.5	1.7	2.2	31.0	17.0	29.0
2	24.1	22.0	24.0	10	7	9	19.2	17.0	19.0	2.1	1.6	2.0	30.0	14.0	28.0
4	24.9	22.5	24.5	12	8	10	20.2	16.2	20.0	2.3	1.4	2.1	29.0	17.0	26.0
5	24.5	21.1	24.0	12	7	10	19.3	15.5	19.4	2.2	1.5	2.2	20.0	15.0	18.0
6	24.6	22.3	24.2	10	7	9	20.1	16.5	19.4	2.2	1.8	2.0	22.0	16.0	20.0
7	25.0	23.0	24.9	10	8	9	18.9	16.0	18.0	2.0	1.3	1.9	23.0	13.0	21.0

8	24.8	20.0	24.7	10	7	9	20.3	17.0	18.9	2.5	1.7	2.2	28.0	17.0	25.0
9	25.6	21.0	25.2	11	8	9	20.5	17.9	19.6	2.6	1.8	2.3	19.0	18.0	18.0
10	25.4	21.5	25.0	11	7	9	21.0	17.3	20.8	3.2	1.9	3.0	24.0	17.0	22.0
11	25.7	22.4	25.5	12	7	9	21.0	16.9	20.6	3.0	1.5	2.9	25.0	17.0	23.0
12	24.0	22.1	24.0	12	7	10	20.0	15.8	19.8	3.1	1.6	2.8	26.0	16.0	22.0
13	24.5	21.4	24.0	11	8	10	19.8	17.4	19.5	2.5	1.2	2.1	29.0	16.0	25.0
14	23.6	20.1	23.2	11	8	9	19.5	17.6	19.2	2.6	1.3	2.4	26.0	19.0	23.0
15	23.0	19.8	23.0	10	8	9	20.5	16.9	20.0	2.4	1.2	2.0	33.0	21.0	31.0
16	23.9	20.2	23.5	12	8	10	20.6	16.8	20.3	2.6	1.3	2.2	31.0	19.0	29.0
17	24.5	20.1	24.3	10	6	9	18.5	15.9	18.3	2.6	1.4	2.2	26.0	20.0	24.0
18	25.5	21.5	25.0	10	7	9	18.6	16.0	18.0	2.3	1.2	2.0	29.0	21.0	26.0
19	24.2	19.9	24.0	11	7	9	20.0	17.0	19.6	2.3	1.2	2.0	30.0	17.0	28.0
20	25.0	23.5	24.8	11	6	8	19.5	17.1	19.2	3.0	1.5	2.6	21.0	18.0	20.0
21	25.1	23.8	25.0	12	6	10	21.0	17.5	20.5	2.1	1.2	2.0	28.0	19.0	26.0
22	23.4	20.0	23.1	11	6	9	21.3	18.9	20.6	2.1	1.2	2.0	18.0	20.0	17.0
23	25.3	20.4	25.0	10	7	9	19.0	16.0	18.6	2.7	1.5	2.1	23.0	17.0	20.0
24	25.1	23.9	25.0	12	8	10	18.6	17.0	18.0	2.5	1.4	2.1	35.0	18.0	32.0
25	24.6	22.4	24.2	11	7	10	20.7	17.3	20.5	2.8	1.6	2.2	20.0	16.0	19.0
26	24.0	21.3	23.9	10	6	9	22.1	16.5	21.9	2.9	1.7	2.4	21.0	17.0	19.0
27	24.8	21.0	24.0	12	8	11	21.0	16.4	20.8	3.0	1.8	2.6	32.0	15.0	30.0
28	24.0	20.0	23.8	12	8	12	19.7	16.0	19.5	3.1	1.9	2.8	23.0	15.0	21.0
29	25.2	22.4	25.0	10	8	10	18.9	15.0	18.5	2.5	1.2	2.1	34.0	16.0	32.0
30	22.9	19.8	22.5	11	8	10	21.0	17.9	20.4	2.9	1.7	2.4	21.0	18.0	19.0
Range	23-25.5	19.8-23.8	22.5-25.5	10-12	6-8	9-12	18.5-22.1	15-18.9	18.0-21.9	2.1-3.2	1.2-1.9	1.9-3.0	18-35.0	14-19.0	18-32.0

B – Black soil, R- Red soil and R+N – Red soil with nutrients

Table 2. Growth measurement of Spinach plants after 30 days

Sample No.	Plant height(cm)			No. of leaves			Fresh weight(g)			Dry weight(g)			Leaf area(cm ²)		
	B	R	R+ N	B	R	R+ N	B	R	R+ N	B	R	R+ N	B	R	R+ N
1	6.2	5.0	5.8	9	6	8	10.0	7.3	9.8	2.0	0.9	1.9	60.0	40.0	58.0
2	6.0	4.9	5.3	8	6	7	12.0	9.5	10.7	1.3	0.7	1.2	55.0	32.0	52.0
3	6.0	5.0	5.5	8	6	7	10.5	7.0	10.4	1.6	0.8	1.4	59.0	35.0	54.0
4	6.1	5.0	5.5	7	5	7	12.3	8.0	11.6	1.4	0.8	1.2	61.0	44.0	58.0
5	6.0	4.8	5.4	9	6	7	12.5	9.2	12.0	1.5	0.5	1.3	62.0	39.0	59.0
6	6.2	5.1	5.8	9	6	7	11.0	6.8	10.6	1.6	0.7	1.4	50.0	33.0	48.0
7	6.4	5.2	5.9	8	5	7	13.0	9.0	12.7	1.8	0.9	1.5	49.0	41.0	45.0
8	6.3	5.2	6.0	8	6	7	10.7	7.6	10.5	1.7	0.4	1.5	56.0	33.0	53.0
9	6.2	5.1	5.9	8	6	7	12.1	6.9	11.9	1.7	0.5	1.6	65.0	31.0	61.0
10	6.2	5.2	5.8	9	7	8	11.5	7.5	11.2	1.2	0.9	1.1	63.0	30.0	60.0
11	6.8	5.2	6.5	9	7	8	10.7	7.8	10.5	1.9	0.5	1.8	70.0	42.0	67.0
12	6.6	5.3	6.2	8	6	7	10.9	9.1	10.6	1.4	0.4	1.2	69.0	45.0	65.0

13	7.0	5.2	6.8	7	5	7	11.6	9.2	11.5	1.9	1.1	1.5	68.0	44.0	63.0
14	7.1	5.4	6.9	9	6	7	10.1	9.0	10.0	2.0	1.3	1.8	52.0	32.0	50.0
15	6.7	5.5	6.3	8	5	8	13.3	7.2	12.9	1.6	1.2	1.2	64.0	47.0	62.0
16	6.8	5.4	6.1	9	5	8	12.6	7.1	12.3	1.5	0.6	1.3	53.0	38.0	50.0
17	7.3	5.2	6.9	9	6	8	12.2	7.0	12.0	2.1	1.2	1.9	57.0	32.0	54.0
18	8.0	6.0	7.2	8	6	7	11.8	8.2	11.4	2.5	0.6	2.1	70.0	45.0	67.0
19	6.9	6.0	6.3	9	6	8	11.3	8.3	11.0	2.3	0.4	2.0	62.0	43.0	60.0
20	7.0	6.0	6.7	8	6	7	12.1	8.7	11.9	2.6	0.3	2.3	52.0	42.0	50.0
21	8.2	6.5	7.9	9	6	8	12.4	7.7	12.0	3.0	1.6	2.7	55.0	31.0	49.0
22	6.1	5.0	5.9	8	6	7	10.5	8.0	10.3	2.3	0.5	2.0	64.0	50.0	58.0
23	6.0	5.0	5.6	8	7	8	11.3	8.6	11.0	1.8	0.6	1.3	57.0	47.0	55.0
24	7.2	5.5	6.8	9	7	8	10.6	9.0	10.5	1.8	0.6	1.3	48.0	35.0	47.0
25	7.5	5.6	7.2	8	6	7	13.0	7.4	12.9	2.0	0.4	1.8	67.0	38.0	65.0
26	6.9	6.0	6.2	7	5	7	12.9	7.5	12.5	1.5	1.0	1.3	69.0	47.0	64.0
27	7.8	6.0	7.2	9	6	7	12.3	9.0	12.1	3.0	1.1	1.0	58.0	43.0	54.0
28	7.5	6.2	7.0	8	6	7	11.3	8.5	11.1	2.9	0.7	2.3	61.0	49.0	59.0
29	7.5	6.1	6.9	9	7	8	11.5	9.0	11.2	2.4	1.0	2.1	54.0	32.0	51.0
30	6.0	5.0	5.6	9	6	7	10.6	9.1	10.3	1.9	0.7	1.4	61.0	34.0	59.0
Range	6.0-8.2	4.8-6.5	5.3-7.9	7-9	5-7	7-8	10-13.3	6.8-9.5	9.8-12.9	1.2-3.0	0.4-1.6	1.1-2.7	49-70	31-49	48-67

B – Black soil, R- Red soil and R+N – Red soil with nutrients

Discussion and Conclusion:

In our investigation the different parameters related to growth of plant such as plant height number of leaves, fresh weight, dry weight and leaf area are measured for plants under study in various soils. It is observed that the values of these parameters for the plants, like spinach, green gram, grown in black soil is higher as compared to the growth of same plants in red soil with nutrients. Whereas minimum values of these parameters are observed in red soil for same plants.

Growth of different plants grown in, black soils, red soils and red soils with nutrients of Wardha district shows a variation due to difference in values of physicochemical properties such as amount of clay content, water holding capacity, bulk density, pH, EC, organic carbon, cation exchange capacity and nutrient supplying capacity. In red soils growth of different plants is less as compared to black soils and red soils with nutrients.

Nutrient content in red soils is low. It is observed that available nitrogen and phosphorus in red soils is low as compared to available potassium. Available potassium is sufficient in red and black soil of Wardha region. These nutrients have great impact on growth of plants. The different mineral nutrients required by plants, are nitrogen and phosphorus. Phosphorus (P) plays a key role in photosynthesis, the metabolism of sugars, energy storage and cell division. Phosphorus promotes early root formation and growth promotes early shoot growth. Nitrogen (N) is of importance as it is one of the most growth and yield increasing nutrients, and is involved in many physiological and biochemical process in plants . Red soil showed improvement in growth of plants under experimentation after application of required nutrient as it is observed that application of nitrogenous fertilizer increases the number of

tillers, panicles and grain yield in plants. Nitrogen plays important role in growth of plants and soil productivity depends upon the effect of interaction between fertilizers/manures and soil physico-chemical properties.

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