A Study on Various Types of Farming and Factors Affecting Crop Growth and Yield

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Abstract - Agriculture in general is a term that is associated with production of food crops. Other cash crops such as jute, cotton etc., are most often neglected. Agriculture–in a broader sense does include Food crops, Cash crops, Plantation crops and Horticulture crops. Despite the boom in technology and engineering advancement, India's economic back bone is Agriculture. The ground breaking genetic engineering or any other advancements in agriculture has not had its optimum usage in real cultivating arena. The hands on the cultivating land has little or no knowledge on recent technical advancement nor do they have expertise in using such improved methods of cultivation. This slackness of knowledge reflects in all the areas that are directly or indirectly connected with agriculture. Setbacks in productions such as poor quantity and quality, leads to poor marketing and disguised unemployment. This reiteration of setbacks, deteriorate the socio-economic wellbeing. This paper focuses on the various factors influencing the growth of plants cultivated in India. Analysis the relationship exists among the productions and factors and addresses the most pressing issues in agriculture.

Keywords: Agriculture, Farming, Plant Growth, Crop Rotation, Crop Seasons, IoT, Farming.

INTRODUCTION

About 70% people of our country are dependent on agriculture farming for their livelihood. Despite such a vast dependency in our country, agriculture is more often overridden sector in the nation. Our government that takes steps for sustenance of agriculture should consider parameters other than finance and technological development too. Enlightening farmers on what to expect in near future in seasonal tendencies and the market requirement is of top most importance.

Once a farmer is aware for what the market requires and understand the environmental conditions for cultivation the farmer is placed well to improve his standard of living. This would improve the overall agro-based industry.

Subsistence Farming:

Majority of farmers in our nation own small pieces of cultivable land which could run to a couple of acres of cultivatable land. Only a handful of cultivators own hectares of agricultural land. The size of the land owned generally dictates the crop and method of cultivation. With a small size of land, the traditional knowledge that farmers usually carry from their forefathers are known to use primitive tools and old farming techniques. It is most likely that these farmers produce are used for their own consumption or use. Hence reaching the open market is quite a challenge due to limited produce and product they manufacture. Products like millets, corn etc., are examples of such farming [1].

Shifting Agriculture:

This is a farming method mostly adopted by people who are nomads and tribes. A piece of forest land is occupied and the area is cleared by felling of trees. The wood collected in used for burning and other purpose such as making a weapon for protection from wild animals. Once the area is cleared, cultivation is done. The most common crops are dry paddy, millets and a few vegetables. The yield per hectare is very low and resources are not used to its best. After a single cultivation, this land is abandoned for further cultivation as this land loses its fertility. This type of cultivation is also a cause for soil erosion[1].

Plantation Agriculture:

This is a method promoted by the British in nineteenth century. One crop is planted in the entire cultivatable land and reap the benefits of the product for a longer time. For example, in hilly areas one can observe tea plantation. Tea is a bush that is planted once and the budding leaves can be harvested periodically for decades together. Generally a tea bush's life time is 100 years. Such plantations require good managerial skills and equipment to deliver the end product. Other products that are under plantation category are - coco, coffee, rubber, apple, grapes, orange etc [1].

Intensive Farming:

In areas where irrigation is not a issue, farmers use high yield variety seeds and proper fertilizer and pesticide to reap the utmost benefits of the efforts put on soil. Uses of advanced machineries are also required for timely seeding and harvesting. The yield per acre of land is high when compared with other types of farming. This intense farming help to cultivate dairy farming also since the byproducts after the harvest will be sufficient to feed the cattle[1].

Dry Agriculture:

This practice is followed in areas where irrigation facilities are lacking. Crops that do not require much irrigation are cultivated in this type of farming. The crops cultivated with proper irrigation are also grown under dry farming. In such circumstances per hectare yields are generally lower. Most of the area under dry cultivation entertains only one crop during the year. This is practiced in drier parts of Rajasthan, Gujarat and Madhya Pradesh etc [1].

Terrace Cultivation:

The sloppy areas of hilly regions when used for cultivation are called Terrace Cultivation. The hill and mountain slopes are cut to form terrace and the land is used in the same way as in permanent agriculture. Since the availability of flat land is limited terraces are made to provide small patch of landscape with even surface. Soil erosion is also checked due to terrace formation on hill slops [1].

Sedentary Cultivation or Permanent Agriculture:

Sedentary cultivation is a process where farmers are settled in a place and use the land available in the surroundings for cultivation. It is also known as settled cultivation. Year after year the same piece of land is used for cultivation. The same crop may not be used year after year. This is the system that is widely followed in India for agriculture produces [1].

Mixed and Multiple Agriculture:

Mixed farming is referred to the cultivation of crops and rising of animals simultaneously. The multiple farming method is consumed by thepractice of cultivating two or more crops parallel together. In this method, normally, multiple crops are chosen based on their varied maturing periods but sown at the same time. The crop that are matured early is generally harvested before the growth of the long maturing crop and therefore there is no collision between the crops growth. This practice is followed in areas having good rainfall or facilities of irrigation [1].

Soil Nutrients:

The nutrients present in the soil is the most important for plants growth. There are several nutrients present in the soil[2].

Nitrogen (N) is required by plants for greenish and leaf growth. It leads to seed and fruit production.

Phosphorous (P) help the plants to make use of the light energy to produce its food. It is very important for formation of protein, germination and also all process of growth of the plant.

Potassium (K) helps in production of good quality of fruits and the reduction of diseases. It is very important for formation of starch, protein synthesis, sugar and carbohydrate.

Calcium (Ca) is essential for plants cell elongation and development of roots.

Sulphur (S)is very essential for plants chloroplasts manufacturing.

Magnesium(Mg) is used in plants photosynthesis process which gives green color to the leaves.

Though there are several other nutrients, the primary macro nutrients NPK are sufficient to determine the soil fertility. Based on the amount of NPK present in the soil, crops can be cultivated in a rotation basis to improve the yield.

Macro nutrient rating of N, P and K for Plants Growth

S. No	Level	Low	Medium	High
1	N(Kg ha⁻¹)	<280	280–450	>450
2	P(Kg ha⁻¹)	<11	11–22	>22
3	K(Kg ha⁻¹)	<118	118–280	>280

Crop Rotation:

This is a method to maintain and nourish the fertility of the soil cultivated. A few crops such as groundnut do not penetrate the soil deeper as the root length is shorter. A few crops such as pumpkin have deeper roots and this penetrate the soil deeper. This brings about soil rotation in natural way and maintains the fertility of the soils. The time between sowing and harvesting is rather shorter as the next crop sowing is likely to take place and shorter time frame. Pulses or any leguminous crop is grown after the cereal crops. Legumes have the ability of fixing nitrogen to the soil. Highly fertilizer intensive crops like sugarcane or tobacco are rotated with cereal crops. The selection of crops for rotation depends upon the local soil conditions and the experience and the understanding of the farmers [1].

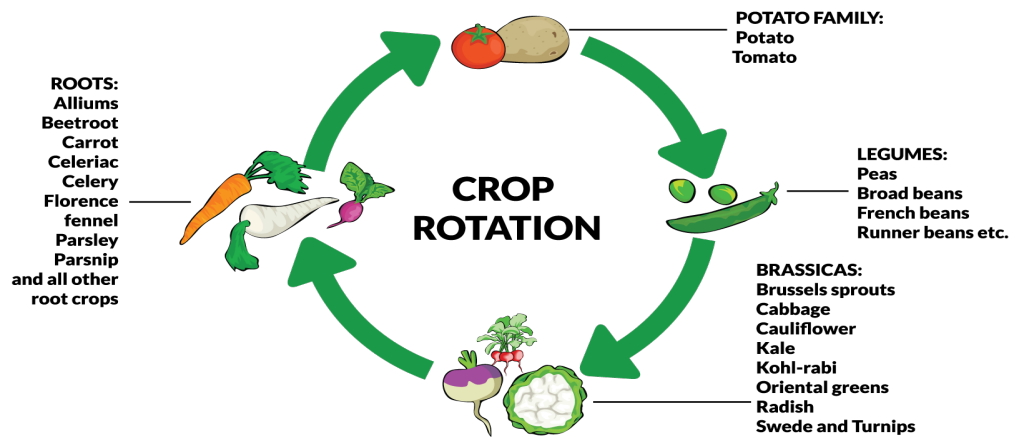The figure 1 represents the sample crop rotation for 4 years.

Fig.1 Crop Rotation for 4 Years

Crop Seasons in India

Crops can be divided into various types based on demographics, seasons, economic value etc. Based on seasons, the crops in Tamil Nadu are divided into three types; Rabi, Kharif and Zaid.

Crops are Sown in June-July when rains first begin (Monsoon crop) and harvested in September-October. It requires lot of water and hot weather to grow. Example: Rice, Jowar, Bajra, Maize, Cotton, Groundnut, Jute, Sugarcane, Turmeric, Pulses (like Urad Dal) etc.

Rabi Crops are sown in October-November and harvested in April-May. Requires warm climate for germination of seeds and maturation and cold climate for the growth. Example: Wheat, Oat, Gram, Pea, Barley, Potato, Tomato, Onion, Oil seeds (like Rapeseed, Sunflower, Sesame, Mustard) etc.

Zaid Crops are grown between March-June between Rabi and Kharif crop seasons. Example: Cucumber, Bitter Gourd, Pumpkin, Watermelon, Muskmelon, Moong Dal etc.

Sowing and Harvesting Seasons of Indian Agricultural Commodities is shown in Fig- 2.

Crops	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	April	May	Major Producing States
Soybean	S	S		H	H								MP, MH, Raj
Cotton (Kapas)	S	S	S		H	H							Guj, MH, AP, MP, Kar
Turmeric	S	S	S				H	H	H	H			AP, TN, Or, WB, Kar, MH
Castorseed		S	S				H	H	H	H			Guj, AP, Raj
Guarseed [Cluster bean]		S	S		H	H							Rajasthan, Haryana, Punj.
Chilli (Kharif)			S				H	H					AP, Kar, Or, MH, WB, Raj
Chilli (summer)			H								S		AP, Kar, Or, MH, WB, Raj
Maize(Kharif) [Corn]	S	S	S	H									Kar, AP, MH, MP, UP
Potato (Kharif)	S	S		H	H								Karnataka, AP, TN
Potato (Rabi)				S	S	S		H	H	H			UP, WB, Punjab, Bihar, Orissa
Wheat				S	S	S			H	H	H		UP, MP, Punjab, Haryana
Maize (Rabi)[Corn]				S	S			H	H	H	H		Bihar, AP, TN, Kar
Rmseed				S	S				H	H			Raj, UP, Punj. Har, MP, WB, Guj
Chana[Gram/chickpea]				S	S				H	H			MP, UP, Raj
Barley				S	S				H	H			Rajasthan
Jeera [Cumin]				S	S			H	H				Gujarat, Rajasthan
Dhaniya [Coriander]				S	S	S		H	H	H			Rajasthan, MP, AP
Black Pepper				S	S		H	H	H	H			Kerala, Karnataka
Mentha	H	H							S	S		H	UP
Cardamom (Perennial Herb)				H	H	H	H	H					Kerala, Karnataka, TN
Potato (North Hills)			H	H	H	H			S	S	S		HP, Uttrakhand
Sugarcane (summer)					H	H	H	H	H		S	S	North India
Sugarcane (spring)					H	H	H	S	S				North India
Sugarcane (winter)				S	S	H	H	H	H	H			North India
Sugarcane (South India)		S			H	H	H	S	S	S			South India, Maharashtra

Fig.2 Sowing and Harvesting Seasons of Indian Agricultural Commodities[3]

Factors Affecting Plant Growth

Factors other than seed and crop are considered as external or environmental factors. Things like, soil, air, atmosphere, seasons, weather, irrigation are a few parameters of external factors that influences cultivation to a great extent [4].

For instance, when soil is considered the parameters that affect the soil's fertility are, the nutrients in the soil, the density of the soil, water retention capacity in soil and the changes that occur in soil in correlation with seasonal changes and with irrigation.

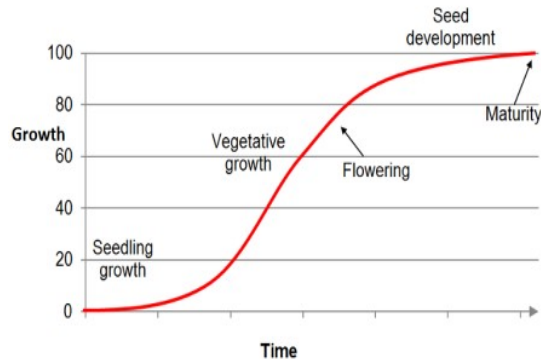The factors affecting the plant growth is shown in Figure 3.

Fig.3 Factors affecting Plant Growth

For saplings a particular variety of soil might be needed. For the sapling to bloom into a crop a different type of soil might be required.

An area that could provide both the variety of soil will be needed for proper cultivation and increased yield.

Temperature: The heat energy in the atmosphere is a very important parameter as this is the source for photosynthesis process for plant growth. The ideal temperature for plant growth is between 60 and 100oF. Extreme heat or cold could kill the plant since lower temperature lessens photosynthesis process and higher temperature evaporates the moisture and kills the plant. Germination process does not need sunlight. Hence winter season will be optimum for seeding. The ideal temperature for nourishing growth will be reached by end of winter and after the germination is completed. Temperature also influences soil fertility by directly influencing the micro-organism that helps in farming. pH values in water content varies with change in temperature.

Radiant energy is quality, intensity and duration of light are important. Quality can't be controlled on a field scale - Feasible on specialty crops. Intensity of light (brightness) is an important factor, photosynthesis happen based light intensity. Photoperiodic Plant behaviour in relation to day length long day plants, flower only if days are longer than same critical period. Some crops fail to flower in certain geographical areas Chrysanthemums can be made to bloom by controlling photoperiod.

Composition of the atmosphere CO2 makes up 0.03 per cent of air by volume. Photosynthesis converts CO2 to organic material in the plant. CO2 is returned to atmosphere by respiration and decomposition. In a corn field or closed greenhouse CO2 level may drop and become a limiting factor in growth. Increasing CO2 can increase crop yields respiration of plants and animals' decomposition of manure or plant residue may release CO2 greenhouse crops. Plant growth and quality can be enhanced by supplemental CO2. Growth responses have been shown with tomatoes, lettuce, cucumbers, flower crops, greens, peas, beans, potatoes. Air pollutants in sufficient quantities are toxic to plants sulphur dioxide - provides sulphur at low levels carbon monoxide, hydrofluoric acid.

Tamil Nadu

Tamil Nadu state has a geographical area of 1,30,058 sq.km. The State is bounded by Bay of Bengal in the east, Indian Ocean in the south, Western Ghats in the west and the States of Karnataka and Andhra Pradesh in the north. For administrative purpose, the State is divided in to 32 Districts, 209 Taluks and 385 Blocks. The State has 10 Corporations, 150 Municipalities, 559 Town Panchayats, 12,620 Panchayat Villages and 93,699 Habitations Physiographically, Tamil Nadu State is divided into Four units viz

> Coastal Plains
> Eastern Ghat
> Central Plateau
> Western Ghats

The coastal Plains stretch over a distance of about 998 kms extending from Pulicat Lake to Cape comerin. Tamil Nadu is predominantly a shield area with 73% of the area covered under hard crystalline formations while the remaining 27% comprises of unconsolidated sedimentary formations. As far as ground water resource is concerned scarcity is the major problem in hard rock environment while salinity is the problem in sedimentary areas [5].

Rainfall

Tamil Nadu is a state with limited water resources and the rainfall in the state is seasonal. The annual average rainfall in the state is 960 mm, approximately 33% of this is from the southwest monsoon and 48% from the northeast monsoon. The rainfall is water source for all the irrigated systems like canal, tanks, bore wells, open wells, etc.

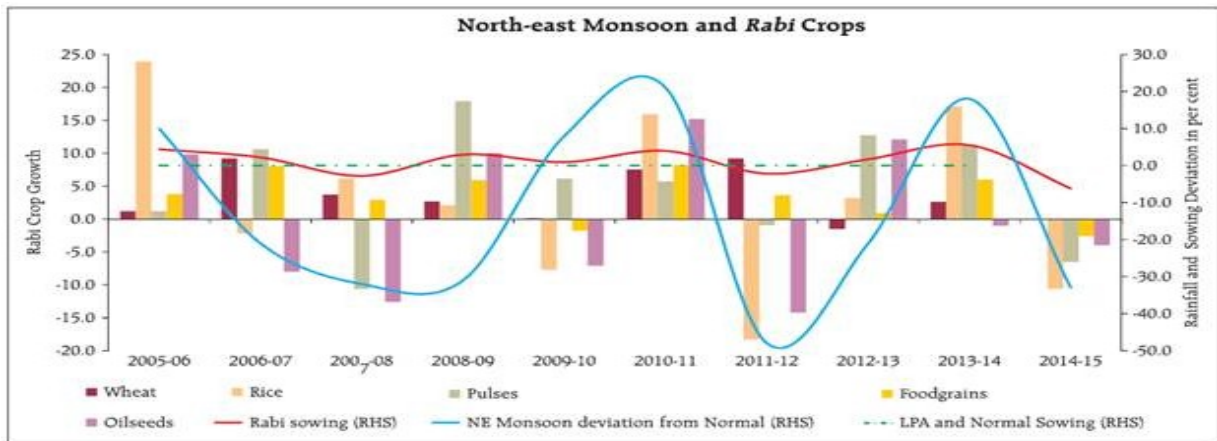The rainfall is directly affect the productions of the all the crops and is depicted in Figure 4.

Fig.4 Monsoon and Indian Agriculture [6]

CONCLUSION

Demographics in general dictate the type of farming and the crop to be cultivated. It has been a traditional method that farmers use till date. The knowledge obtained by most farmers is hereditary in nature. The same methods of cultivation are used that were used by forefathers. Many parameters over the years have changed. Right from rainfall, fertility of the soil, atmosphere and pollutions in water, air and noise have had drastic changes. Over the decades, change in agriculture farming or adoption of newer methods and technologies are almost negligible. With proper use of technology that works from down to earth approach will help farmers improve their production. The foremost consideration to assist farming is demographics. Demographics include all the details of soil, atmosphere, weather, seasonal tendencies, rainfall etc., Then comes the type of crop that are suggestible for farming. For instance, a dry area can be suggested to have plant cash crops such as jute and hilly areas that have more moisture content in the atmosphere can the suggested to cultivate plantations such as tea, coffee and a plain areas which have water availability to be cultivated with dairy farming. This would be a system with appropriate algorithm that incorporates all the data and updates the necessary data and exclusive analysis is run and optimum suggestion for better agriculture will be provided. Latest technologies like big data analytics and internet of things can be incorporated into farming for maximize the production.

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