AGRO-PHYSIOLOGICAL FACTORS AFFECTING BIOLIGICAL CROP POTENTIAL (OR PRODUCTIVITY)

I Seed : First important thing in crop raising is seed. It is like a nucleus in the cell which a pivotal role in crop production. It provides basis for production. As crop depends on seed, so first parameter is

1. Quality of seed: It should be of good quality. Seed should be of recommended variety. Two tests are performed to test quality of seed.

(i) Purity test
(ii) Germination test

Seed is of good quality if it is (1) Genetically pure. This is pre-requisite for good quality seed. There is possibility that seed may contain weed seeds, straw, dust particles which can affect germination. So seed should be free from these.

It should have good germinability. Should be free of insects and diseases. There should be no mixture of cultivars.

II **2. Seed rate:** seed rate is very important factor. To get optimum plant population, optimum seed rate is required. Parameters for seed rate are

(i) Seed quality: It should be of high quality, should be pure, have good germinability.
If in wheat purity is 99% and germinability is 98% then use 40Kg seed /acre.
If purity is 99% and germination is 96% then use 45-50 Kg/acre.

(ii) Soil conditions: proper soil tillth (final physical fitness of soil after going to different operation. Seeds are sensitive to soil tillth. Seed bed is prepared according to the choice of seed.

(iii) Soil moisture: seeds having hard seed coat require more moisture. Germination is affected by soil moisture.

(iv) Sowing time: It depends on soil temperature and soil moisture.
Optimum temperature is required for germination of seeds. e.g. Best time for wheat is first forenight of November. Wheat can grow from sea level upto 4000m at temperature 3-4 C But best temperature is 22-25C. This temperature is on average bases.Soil moisture: Germination is facilitated by soil moisture. If rainfall is not uniformly distributed, then it affects germination. Late sowing, low plant population and yield is effected.

III **SOWING METHODS/ TECHNIQUES:**

1. **Broadcast:** Very old method. Seed is broadcasted manually, seed not attain proper depth. Skilled man is required otherwise patches are formed. If proper distribution is attained then proper depth is not attained.

Disadvantages over line sowing:

- Inter-cultural practices are not easily possible.
- Light penetration is not proper.
- Not proper nutrient management.
- Proper plant population is not successfully maintained.
- Seed quantity used is less in line sowing, 5-10 Kg less seed is used in line sowing.

2. **Ridge sowing:** For maize only 4-5 Kg seed is required. We determine depth of seed. We put two seeds per hill.

Almost 40-50% water is saved as compared to flat irrigation and decreases cost of production.
Salt leaching occurs and some salts accumulate on the ridge and we sow seeds accordingly.

3. **Line sowing:** Distance between rows depends on crop type. Different crops have different root systems, upper ground biomass of crop, Growth behavior.

We can maintain plant population / unit area.

Machines can be used for sowing, harvest, and other operations. This is done where soil is flat and done on plank.

In areas where we cannot properly prepare soils (e.g. rice and cotton areas) then line sowing is not possible. Broadcast is then used. More seed rate is used. In late sowing areas we use broadcast method.

IV. SOIL:

Soil is very complex factor. It contains lot of living and non living organisms.

Characteristics of soil:

1. **Type of soil:** Number of soils are available in our country. These soils have different formations. Two characteristics which determine type of soil are texture and structure of soil. Texture is size of soil particles and Structure is arrangement of soil particles.

   Crops have a choice for soil based on behavior and root system. Some plants have roots as economic value. Some have grain as economic part. Here we consider Arial parts. Loose soils are favorable for plants where roots are economic parts. i.e. Groundnut.

   For majority of crops medium loam soil is considered best. Few have demand for clay soils e.g. Rice.

   Root crops ---------- Sandy soil / light soil

   Rice---------- Heavy loam soil

   Soil choice depends on growth behavior.

Broadly speaking soil is divided into three classes.

(I). Light loam (II). Medium loam (III). Heavy loam soil

2. SOIL TILLTH:

Well pulverized seed bed is required for maximum biological potential.

3. LEVELLING:

Soil leveling is very important for maximum potential. If unleveled soil, cotton seeds on lower patches will not germinate because of accumulation of water in that patch.

Seeds on high patches will also not grow due to non availability of water.

Precision land leveling; when land is leveled at zero level. By it land water use efficiency increases. It ensures maximum seed germination.

4. NUTRIENT STATUS:

This is soil reserves. Crop is feed on soil nutrients. So it is soil which determines crop growth period and its vigor. Crop may be short duration, it may not be more dependent on soil, so medium soil is required. Long period crops require more fertility. They require soil reserves for longer period. More rich, more fertile soil would be, it will be good in reserves.

There are some points, which make the soil rich. One of which is Organic Matter. Generally soil fertility is determined on mineral nutrients. 16 elements are essential for normal germination.

9 Macro elements; C, H, O, N, P, K, Ca, Mg, S

7 Micro elements; Cu, Fe, B, Zn, Mo, Cl, Si, Na, Co, Al

There are some additional elements, which are required for some crops. e.g.

Si is required for Rice.

Co is required for legumes (for N fixation).

Na is required for sugar beet.

For normal soil it should contain;

5% (on weight basis) Organic Matter.

45% in organic material.

50% pores (macro and micro pores) porosity occupied by water and air.

ORGANIC MATTER:

In addition to improving soil structure, it is directly related to crop. If soil structure is good, then better root system and better germination.

Direct effects, source of nutrients for plants.

Indirect effects, it improves porosity and water holding capacity.

It organic matter is more, then more response to fertilizers and vice versa.

SOIL MOISTURE:

It is pre requisite at seedling. Germination is facilitated by soil moisture. If rainfall is not uniformly distributed, then it effects germination. Seeds, who have hard seed coat, require more moisture. It depends on soil condition. Organic matter holds water for long period of time. For germination, for later growth and development moisture is important. At planting, soil should have proper moisture and organic matter.

IV) FERTILIZER MANAGEMENT:

On an average, generally it is said that quality seed increases 25% yield, fertilizer use increases 50% and crop management 20-25% and crop protection contribute 15-20%.

As far as fertilizers are concerned, these points should be kept in mind.

1. Type of fertilizer
2. Rate of fertilizer
3. Time of application
4. Method of application.

Identified deficient elements are N, P, and K.

In Rice tract Zn is also deficient along with N, P, and K.

Fertilizer is a precious element. Judicious use of fertilizer is very important. We cannot bear loss of fertilizer. Most farmers use fertilizer when it is available. They cannot look at timing, rate of fertilizer and requirement of crop. These bases should be known to farmer as to avoid mishaps. Time of fertilizer application, Method of fertilizer application and proper handling results in higher crop production.

Usually farmers use Urea(N). No doubt it remains deficient in soil as compared to P and K, but its efficiency in soil depends on P and K also. Our farmers are ignorant of this fact. They use it with no choice. First desired thing is that each element should be used in balanced form. If N is in excess, it effects P availability.

Choice of element depends on

Soil type and its initial fertility level.

Crop to be grown on that soil.

Water availability.

These factors help us to make a good combination.

Dose of fertilizer is estimated then time and method of fertilizer application is also important because these three factors effects efficiency of applied fertilizer.

Crop stage also have different demands of rate & type of fertilizer . if a crop has 8-9 growth stages, it does not show demand of fertilizer at all stages.

Our fertilizer application should coincide with maximum activity of plant i.e. at peak.

This is related to time of application.

METHODS OF FERTILIZER APPLICATION EFFECTING AVAILABILITY OF FERTILIZER:

1. **BROAD CAST METHOD:**

In this method fertilizer is manually distributed. During seedbed preparation it is broadcasted in the field, keeping in view N, P, K.

N------ is highly soluble and mobile

P------ is immobile

K------ is partially mobile

P & K (being slowly available) are applied before or at the time of seeding i.e. during seedbed preparation.

N should be applied when plant can make best use of it because it is lost by volatilization and by leaching. N remains available to plant it water is available.

N is applied in splits not in bulks. Keeping in view the behavior of crop in 2-3 splits. Generally 1/3rd N along with P & K at seeding. 1/3 or 1/2 later on according to crop demand.

Demerits; fertilizer can not be uniformly distributed in the field, leading to poor performance of the crop effecting growth and development.

Drilling: For it there are two methods. Banded application of seed and fertilizer. In one case there is a combined drill. Seeds and fertilizer are placed in the soil, fertilizer dropped 2-3"and seed dropped 1-2". Side drilling; in second case fertilizer and seeds are dropped at two parallel lines or rows.

- As compared to broadcast, these methods increase 50-70% yield over broadcast.

RELATIVE EFFICIENCY OF BROADCAST & BANDED APPLICATION OF FERTILIZERS

General introduction: Fertilizers are limited in supply, and are called costly inputs. Fro achieving maximum benefits from such inputs, it is recommended that their application should be at proper time, proper sight and by correct method of application. If they are applied much earlier than required, they may be lost in various ways (common ways are volatilization and leaching) & thus their use efficiency may be less than expectation. Similarly if they are not applied at proper place, they may not be properly utilized by the plants and thus the necessary objectives may not be achieved.

These four areas ensure fertilizer use efficiency

1. Type of fertilizer
2. Rate/ Dose of fertilizer
3. Time of application
4. Method of application

TYPE OF FERTILIZER. It depends on soil fertility level, type of crop to be sown.

RATE/ DOSE OF FERTILIZER: It depends on type of soil, soil fertility level

Lighter soils--- less ability to capture nutrients.

Medium loam soil is considered to be the best soil.

On heavy soil--- fixation of nutrients occurs. Current crop cannot make use of full nutrients applied.

WATER AVAILABILITY:

Fertilizer use efficiency completely depends on the water availability. Major difference between barani and irrigated areas is of water. Water resource is also important in fertilizer use efficiency.

In Barani areas dose is 50% less as compared to irrigated areas even variety is same, difference is due to water availability.

TIME OF APPLICATION:

It depends on the following factors.

1. Demand of the crop in question: All crops do not have uniform demand for nutrients. All plants have not same kind of physiological activities. So time of application depends on stage of maximum activity of the plant.
2. Temperature: Prevailing temperature greatly influences fertilizer efficiency. It is optimum temperature that increases fertilizer use efficiency.

During summer avoid to apply fertilizer at midday because high temperature causes loss of fertilizer.e.g. Volatilization. Apply at early or late.

In winter, apply fertilizer at midday. Avoid to apply at very low temperature.

METHOD OF APPLICATION:

Common practice is broadcast which usually leads to loss of the precious input. Band application is also adopted. Scientific method is drilling. Experiments show that fertilizer placed below or above the row with drill increases 50-80% yield as compared to broadcast.

VII - **IRRIGATION MANAGEMENT:**

It is more precious than fertilizer. Water has nucleus importance in plants and animals. Our productivity greatly depends upon water resources. It should be used judiciously and carefully.

CONSIDERATION REGARDING IRRIGATION MANAGEMENT:

1. Irrigation Frequency: We should be aware of the total requirement of the crop (delta of water) and then divide or quantify it in number of irrigations to be applied.
2. Irrigation scheduling: If we are to raise wheat with four irrigations, this is scheduling or planning which will manage it. 1st to be applied about 15 days after seedling emergence i.e. after 15-20 days of sowing. 2nd irrigation at booting stage(a stage known as where spikes start to develop but remain under leaf. 3rd at the time of pollination and fertilization. When spikes come out of the flag leaf. 4th irrigation during early seed formation(milk, dough, maturity)

Agronomic approaches carried out for water conservation at field level:

(i) Mulching: mulch, a check created under soil to minimize evaporation of water from soil surface. Simplest method of mulching is hoeing or interculturing.

(ii) Addition of certain organic matter in the soil , use of FYM , Green manuring , or any other industrial waste can be used. Organic matter improves the water holding capacity of the soil.

STRATIGY FOR WATER SAVING:

Sowing of crop on ridges or on beds. Experiment has shown that sowing on beds saves seed, labour, in addition much water is also saved because in this case no conyance losses, no channel losses. At least 50% water is saved. In this case also maximum utility is derived because it remains available for more period of time. So at field level, it is good to sow crop on ridges.

VII - **INTER-CULTURAL TILLAGE:**

In standing crops, for providing better environment to the plants it remains important to inter culture the land. Sometime hoeing is done on small scale (to open the soil for light penetration, increases aeration, controls weeds, air circulation).

It should be carried out for all crops. In inter culture we use implements especially in row crops. In aerable it is actually done. Its intensity depends on soil and crop. If heavy soil & more weeds then more number of inter culturing.

EARTHENING-UP:

After inter culturing it is done in single stemmed plants which are long growing to avoid lodging. It increases production. Earthening up is mostly done manually. It is a management approach.

VIII - **PLANT PROTECTION:**

Plant protection is important for good crop production. Plant should be protected from weeds, insects, and diseases.

WEEDS: (unwanted plants in the field). They compete for water, light, and nutrients. So they should be kept under control. If they are not completely eradicated, they should be decreased to an extent that is not harmful. There are two means to control them. Cultural means and use of chemicals (weedicides).They can cause reduction 5-80%of production.

INSECTS: They can damage crop in several ways. Seed is mainly the carrier for insect population.

DISEASES: They are serious enemy of crops. Diseases are some times epidemic in nature. Heavy attack of diseases can reduce yield to heavy extent. Seed should be free from disease organisms. Without controlling these we cannot imagine about good yield. Now it has become a common phenomenon to protect plants because facilities are available. There are chemicals available called fungicides for treating seed of crops, which are specific. They are effective against seed born diseases.

This is integrated approach to go for weeds, insects, and diseases (IPM)

Physiological PHYSICAL FACTORS

(1) LEAF AREA

All branches and tillers contributes towards the leaf area. There are two major parameters

1- temperature 2- light

It is number of leaves per plant per unit area. Temperature and light intensity are the most important factors influencing the expansion of leaf canopy. Optimum temperature for leaf production and expansion like in the range of 20-30 centigrade . low temperature is a critical factors limiting leaf expansion. Light has two components

1- light intensity 2- day length / light duration

High light intensity results in faster rate of photosynthesis and there are more carbohydrates available for leaf production and expansion. Similarly as day length increases so photosynthesis production will increase. Day length also affects the rate of plant development. Plants grown during long days take short time to reach maturity than the plants grown during short days. In the fields , the main agronomic factors influencing leaf production is sowing date because it ultimately influences the rate of plants development .

It is concluded that by agronomist, we have given attention on the optimum sowing time where optimum temperature is available , we have better crop stand. So, emphasis is given on the planting time , so more harvest can be obtained

Leaf area as described in terms of leaf area index = leaf area/land area

how this leaf area intercept light and how light affect photosynthesis?

Most of the experiment have shown that there is a close relationship between leaf area index and crop growth rate. In order to achieve high growth rate a high LAI is required. If LAI is reduced due to drought, salinity, nutritional stress or disease and insect attack. The crop growth and dry matter production will be reduced.

Crop growth depends upon total photosynthesis activity of green leaf area which is ultimately expressed in terms of amount of dry matter produced per unit leaf area per unit time. The base or substrate of plant activity is the leaf, growth is defined as the increases in size and weight of cell. There is cell multiplication, cell division and cell expansion resulting in increases in size and weight. Growth depends upon photosynthates produced by the same plant. Basically plant produces its own food that are utilized by the same plant.

(2) CROP GROWTH RATE AND NET ASSIMILATION RATE

Chris periodical at any stage CGR can be measured. NAT is measured when crop near to harvest. CGR is increase in weight / unit time / unit area.

Total net gain by the plant over a net gain. The concept of NAR studies assume that all leaves are uniformly lit and and that all leaves may get equal contribution in p/s. this is not the case in normal crop canopy where lower leaves are shaded by upper leaves. Emphasis is now placed on determining the amount of light actually intercepted by the crop canopy. The proportion of incoming radiation intercepted by plants can be determined by measuring the light intensity above and at the base of crop canopy by using a suitable light mete. Generally leaf area index increases the percent of incoming radiation but this relationship depends upon canopy, structure, lax or prostrate leaves will intercept more light than erect leaves. Hence at low leaf area index there would be greater light interception in case of lax leaves than the erect leaves.

CALCULATION OF LEAF AREA

(1) rough method / estimated method ; max. length × max. width = cm^2

(2) graph paper method = estimated × c.f

c.f = exact leaf area / estimated area

If square is less than half then it is neglected. If more than half then take to full .one square is equal to $0.0625cm^2$.

WHY WE CALCULATE LEAF AREA

1- simply tells us about the leaf size
2- leaf area index = leaf area / land area

every crop has different optimum leaf area. LAI depicts simply the size of the leaf.
Large size leaves are difficult to measure. First we need leaf area, dry weight, LAI, LAD, CGR, NAR. Dry weight is for CGR and whole growth development of the plant
For example size of the plot = $1.8m \times 5m = 9.00\ m^2$
All the leaves in the plot are first taken off and taken fresh weight 500 grams then take subsample 15-20gm and measure the leaf area of that

For whole leaf area = $120/20 \times 500cm^2$

Then 15-20gm under sundrying and then oven drying for 48 hours. If weight is less than original by oven drying, if constant weight is obtained, then we calculate dry weight. If dry weight is taken then successive readings are taken for whole growth period. Stresses may also reduce leaf area .

(3) FUNCTIONAL ACTIVITY OF LEAF PHOTOSYNTHESIS OR METABOLIC ACTIVITY OF LEAF

Carbon dioxide and water in the presence of light and cholorophyll makes carbohydrates and ~~water~~ oxygen.
There are three major steps involved in these processes.

1- diffusion of co2 from the atmosphere through the stomata to the chloroplasts in the leaf .
2- interception of light by the chloroplast and to convert light energy to chemical energy.
3- Use of this energy to reduce co2 to carbohydrates .

FACTOR AFFECTING THE PHOTOSYNTHESIS

There are number of factors which affect the process. Some may affect direct, some may affect indirectly

- Water availability limited availability affects photosynthesis .
- NUTRIENT; some nutrients are essential components of chlorophyll ,N, Mg etc. for the functioning of chloroplast ~~pigment~~ to produce chlorophyll, essentially of N and Mg must be include. Phosphorus is also essential to produce energy converting ADP into ATP.
- ~~Pollution may be environmental or soil, there are some pollutants in soil which indirect affect p/s.~~
- Leaf area affect p/s. if optimum LA is not available, photosynthetic efficiency is reduced. Proper number of plants per unit area provide the base to the leaf area .
- Architecture of plants / arrangement of the leaves.
- Leaf age determine p/s efficiency.
- Carbohydrate translocation ; there are two place in leaves where photosynthates are produced called source and where photsynthates are utilized called sink. So efficiency of p/s depends upon carbohydrate translocation.

THREE FACTOR WHICH IMPART PHOTOSYNTHESIS

- ✓ CO_2 ; concentration of carbon dioxide limits its step in p/s .
- ✓ Light ; light intensity limits step 2.
- ✓ Temperature ; limits step 3.

INTER- RELATIONSHIP BETWEEN THESE FACTOR

GRAPH

- Curve A shows the affect of light intensity on the rate of photosynthesis under the normal atmospheric carbon dioxide concentration. As light intensity increases the rate of p/s increases , reaching a maximum at light intensity. After this stage there is no further increase in rate of p/s with further increase in light intensity. Hence we say that p/s has become light saturated. At normal atmospheric carbon dioxide concentration temperature also has little affect on the rate of p/s .
- If carbon dioxide concentration is increases p/s rate also increases but again it becomes light saturate at higher intensity as shown in curveB.
- At above normal carbon dioxide concentration under high light intensity the rate of p/s increases with increase in temperature. The efficiency of p/s depends upon the pattern of leaf growth when the time of maximum leaf area coincides with the time of maximum incoming solar radiation. Hence the improve dry matter production , it becomes important to adjust planting time of a crop in such a way that maximum leaf area index is obtained at a time when there could be high light interception resulting in increase in photosynthetic activity .

RESPIRATION

It is a biochemical process in which carbohydrates are broken down to release energy and this energy is ultimately utilized in the growth and development of plant through different processes. At the field level, the factor influencing the rate of respiration. The rate of respiration is doubled for every ton degree rise in temperature. However the rate of photosynthesis os little affected by temperature over the range 20-30 det54 under normal condition. Hence high temp results in larger losses of carbohydrates (so unusual rise in temp causes photorespiration in c_3 plants). These losses are particularly important in storage organs as the roots or the grains which are the sites of high level of metabolic activity. (the adverse effect of temp should be at the build up of plant either growing plant or mature plant).

In C_3 species between 20 and 50 % of the carbon fixed by photosynthesis is immediately respired. This process is referred as photorespiration and is apparently wasteful whereas c4 species do not show photorespiration and therefore often have higher rates of photosynthesis and faster crop growth rate than c3 species. At the later stage of growing season, LAI declines as no new leaves are formed and the older leaves embraces senescence, hence the proportion of respiring to photosynthetic tissues increases. Moreover, high temperature at this time will hasten senescence and will increase respiratory losses.

SOURCE SINK RELATIONSHIP:

Movement of assimilates in plans often considered in terms of sources and sink. The most important assimilate considered in this way is the carbohydrates produced by photosynthesis. A source is any site of metabolic activity which releases carbohydrates for uses elsewhere in the plants whereas a sink is a site where assimilates are received and utilized for the plant growth and development. Individual plant organs can be sinks during early stages of development and sources later on or vice versa e.g leaves. The pattern of carbohydrates distribution within the plant is not constant rather it changes with the growth and development of the plant.

PATTERN OF ASSIMILATE DISTRIBUTION IN CEREALS:

During vegetative growth the newly expanded and emerging leaves retain all the carbohydrates. They produced and also import carbohydrates from older expanded leaves. Fully expanded leaves need to export carbohydrates to new leaves, the shoot apex, tillers and roots at the start of reproductive growth, the pattern of assimilate distribution changes. The developing ear and elongating stem become more important sink receiving carbohydrate from the upper leaves of the stem. The lower leaves at this stage export carbohydrate to the roots whereas during grain filling, almost all of the carbohydrates produced translocated to the ears.

FACTOR AFFECTING SOURCE SINK RELATIONSHIP:

Source sink relationship is influenced by the number, size and proximity of the competing sinks on the plant. Sinks which are receiving carbohydrate, at the same time, may compete with each other. In cereals the proc

of stem extension takes place at a time when the ear is almost growing rapidly. It is frequently suggested that the elongated stem id a dominant sink and its demands reduce the supply of carbohydrate available for ear growth. In the same ear, there is a different pattern of assimilate distribution. The largest grains are found in the centre of the spike because these florets are the first to reach anthesis while the grains at the top of the ear are usually much smaller than those in the middle and at the base of the ear.

SEVERAL OTHER FAVTKORS AFFECTING SOURCE SINK ARE :

These could be some physical or physiological level

- The activity at the sink can influence the activity at the source because there is established evidence that feed back mechanism exists .
- Secondly, yield could also be limited by the capacity of the translocation system to transport carbohydrates.
- Thirdly, the relative activities the source and sink can change in cereals short after anthesis. There is a large source (flag leaf, second leaves, ears and stems) but the capacity of sink to accept carbohydrates id limited as the developing grains are small. At a later stage as the grains increase in size their capacity to receive or accept carbohydrates also increases but at this stage the area of green tissues decline due to senescence hence the source capacity decreases. Therefore during early stages of grain development it is the sink capacity which inhibits the yield because at this stage, the excessive carbohydrates produced are not fully utilized by the developing grains at later stage, it is the source which limits grains yield because its decreased capacity can not meet the requirement of the larger sink.

MESSAGE FOR PLANT BREEDER / MANIPULATION OF SOURCE-SINK RELATIONSHIP

Through different research investigation, the information have been collected whether the activity of the source or the capacity of the sink limits yield. Such information is of direct interest to plant breeders. If yield is limited by the capacity of the sink then breeders could increases yield by selecting a larger sink (more& bigger grains). If yield is limited by the capacity of the source that is the ability of flag leaf to produce carbohydrates to fill the grains then the choice with the breeder remains to increase yield by selecting the larger flag leaf which stays greener for longer time.

ECOLOGICAL OPTIMA

Every living thing (human beings, animals, plats) show maximum response to the environmental inputs (weather or agricultural inputs) at a certain level which is called the ecological optima. Organisms respond to any environmental parameter according to any environmental parameter according to a common pattern as a parameter increases it reaches a thresh hold level above which it begins to show an affect, after which the response increases gradually until the system becomes saturated by that parameter then if the parameter level or concentration continues to increase, response remains constant of begins to decrease and sometimes it becomes toxic or inhibitory. This is called the principle of saturation. For example there is a minimum level of nitrogen at which plants shows it response and the response increases with the increase of nitrogen application until a stage will come when the plant is saturated and it stops showing of response. The plant capacity to perceive an input is saturated and further increase has no effect of show negative effect. This common behaviour demands that there should be an optimum level of the parameter required for normal plant activity.

HOW WE CAN OPTIMIZE THE ENVIRONMENT FOR THE PLANT

1) We should select a right crop for the right area.
2) We can manage the application of proper amounts of inputs like fertilizers, water and chemicals (weedicides, pesticides, fungicides) and their Application should be when there would be a threshold level observed at the field level. Most of the agronomic practices are aimed to alter the environments and to optimize the environmental condition of plants according to their requirements .

LAW OF TOLERANCE

Plants tolerate some minimum and maximum level of input material or weather parameter and don't normally respond to a level below minimum and will behave differently above the maximum. This is called the law of tolerance and the range between minimum and maximum in called tolerance range.

LAW OF MINIMUM (LIEBIG' S LAW OF MINIMUM)

A scientist liebigs published a book during 1840 where he appoint about this theory which is now called liebig's law of minimum. He reveals that the growth of a plant is dependent upon the amount of food presented to it in a minimum quantity. When the level is increased even in small a amount, the plant responds to it and its growth increases.

SYNERGESTIC EFFECT/ SYNERGISM

When the interactive effect of two or more than two factors is more than the sum of their individual effect, it referred as synergism/ synergistic effect.

ANTAGONISTIC EFFECT / ANTAGONISM

When the interactive effect of two or more factors is less than the sum of their individual effects, it is called antagonism/ antagonistic effect.

DETERMINANTS OF CROP GROWTH

A. The amount of light energy intercepted by the crop if light interception is more , normally there will be more growth and vice versa.
B. The efficiency with which the crop uses intercepted light in the production of dry matter (relationship between source and sink).
C. The duration of active growth periods If a crop where dry matter production and accumulation will occur more the duration, there will be more dry matter production and accumulation.
D. The ability of plant to convert or partition the dry matter into economic yield .

FACTORS LIMITING AGRCULTURAL PRODUCTIVITY IN THE COUNTRY

Although the country has abundant natural resources capable of substantially higher agriculture production than that at present. There are several major biological, economical and social constraints which limits agricultural production in the country. These include;

1. High population growth rate about 2.1% per annum. It present Pakistan population about 140 million and even with optimistic assumption of declining growth rate, population is expected to be about 150 million in for the year 2005 . (ideal growth rate is 1.7 %)
2. Very low man – land ratio of cultivated land which is 0.38 hectare per capita (81% of total farm where area < 12 acres) .
3. Loss of good cultivated land due to water lodging, salinity, soil erosion besides being brought under roads, buildings or industries.
4. Periodic occurrence of floods and drought .
5. Wide spread prevalence of insects and diseases of crops.
6. Absence of site specific package production technology for the important agricultural crops in various agro-ecological zones.
7. Inefficient agricultural extension system for transfer of technology.
8. Inadequacy of well organized marketing systems for the maximum benefits of the producer.
9. lack of well organized closely co-ordinated agricultural research system .