MAHARASHTRA AGRICULTURAL UNIVERSITIES EXAMINATION BOARD, PUNE
SEMESTER END THEORY EXAMINATION
B.Sc. (Hons.) Agriculture

Semester	: III (New)	Term	: I	Academic Year	: 2023-24
Course No.	: AGRO 235	Title	: Rainfed Agriculture and Watershed Management		
Credit	: 2 (1+1)				
Day & Date	:	Time	:	Total Marks	: 40

Model Answer Set

Note : 1. Solve **ANY EIGHT** questions from **SECTION "A"**.
2. All questions from **SECTION "B"** are compulsory.
3. All questions carry equal marks.

SECTION "A"

Q.1 Write in brief about agronomic measures for soil and water conservation in rainfed agriculture 8M

ANS:- The following agronomic practices are useful for soil and water conservation in rainfed agriculture and to be considered in coordination with others effectiveness. These measures are effective on gentle slope up to 9 percent. Reduction in runoff is achieved.

i) **Counter cultivation :** Tillage operations viz., ploughing, harrowing, sowing and interculture should be done across the slop of land. This will help in creating obstructions to the flow of water at every furrow, which acts like a small bund and results in uniform distribution of water. This helps more infiltration of water less run off and erosion and gives higher crop yield. Any cultivation done along the slop will accelerate gully formation, more run off and erosion and consequently permanent damage to land.

ii) **Land preparation:** Land preparation including post-harvest tillage influencing infiltration, obstruction to surface flow and rate of erosion. Deep ploughing is effective in reducing erosion. Rough and cloddy surface is also effective in controlling erosion. Tillage alters the soil physical characters like porosity, bulk density, surface roughness and hardness of pans. Conventional tillage: Conventional tillage includes ploughing twice and thrice, followed by harrowing and planking. It leaves no land unploughed and leaves no residue on the field.

Conservation tillage: Conservation tillage disturbs the soil to the minimum extent necessary and leaves crop residue on the soil. Tillage system (minimum and zero tillage) can reduce the soil loss by 50% over conventional tillage.

iii) **Choice of Crop :**Row crops (erosion permitting crops) such as sorghum , maize, bazaar etc. are not effective as erosion resisting crops such as cowpea, groundnut, green gram, black gram etc. Generally, legumes (smothering crops) provide better cover and protection to soil by minimizing the impact of raindrop and acting as obstruction to runoff.

iv) **Dense growing crops:** Growing a crop which produces the maximum cover, reduces runoff and soil loss. Cowpea, greengram and groundnut important cover crops for rainy season. These crops give early and dense ground cover (85%) which generally coincides with peak rate of runoff.

v) **Strip cropping :** This consist of growing of few rows of erosion permitting crops and erosion resisting crops in alternate strips on counter with the objective of breaking

long strips to prevent [illegible] and [illegible] permitting crops like [illegible] sorghum, bajra etc. which allow the runoff water to flow freely without [illegible] the erosion resisting crops i.e. mainly legumes like groundnut, horsegram, soybean. Erosion resisting crops reduce transporting and eroding power of water by obstructing runoff and filtering the sediment from the runoff to retain in the field

vi) **Organic manure and fertilizers :**Oranic manures improve physical condition which results in improvement of infiltration rate leading to reduce runoff. Fertilizers improve vegetative growth which helps in erosion control.

vii) **Mulching :** A mulch is natural or artificially applied layer of plant residues or other material on the surface of the soil with the object of moisture conservation, temperature control, prevention of surface compaction or crust formation, reduction of runoff and erosion, improvement in soil structure and weed control. Artificial mulches of different kinds such as Jowar or bajara stubbles, paddy straw or husk, saw dust etc. increase absorption of water and minimize evaporation. They also control run off and soil loss.

viii) **Crop rotation :** Crop rotation means growing a set of crops in a regular succession over the same field within a specified period of time. Continuous growing of Jowar or bajara crop causes more erosion, but if followed by alegume crop viz., hulga, matki or gram which covers the soil is causes less erosion. Rotation also helps in removal of plant nutrients in a uniform way from future depth of soil, helps in conservation of moisture and maintaining the fertility of soil.

ix) **Cropping system :**Mono cropping of erosion permitting crops accelerate soil and water loss year after year. Intercropping of erosion permitting and erosion resting crops or their rotation have found effective for soil and water conservation. Legumes are effective for soil conservation due to smothering effects they should be sown in time to develop adequate canopy by the time of peak rate of runoff.

Q.2 Define water harvesting and explain in detail different techniques of water harvesting for semi arid region. 4M

ANS:-Water harvesting : The processes of runoff water collection during peak rainfall periods in storage tank, farm pond is called as water harvesting. Its further use for crop production is called runoff farming.Or Collecting and storing of water for subsequent use is known as water harvesting. It is method to induce, collect, store and conserve local surface runoff for agriculture in arid and semiarid regions.

Water harvesting techniques followed in semi-arid areas are numerous and also ancient.

Dug Wells : Hand dug wells have been used to collect and store underground water and this water is lifted for irrigation. The quality of water is generally poor due to dissolved salts.

Tanks : Runoff water from hill sides and forest is collected on the plains in tanks. The traditional tank system has following components viz., catchment area, storage tank, tank bund, sluice, spill way and command area. The runoff water from catchment area is collected and stored in storage tank on the plains with the help of bund. To avoid the breaching of tank bund, spillways are provided in the central area of the tank bund to allow controlled flow of water into the command area.

Percolation tanks :Flowing rivulets or big gullies are obstructed and water is ponded. Water from the ponds percolates in to the soil and raises the water table of the region. The improved water level in the wells lower down the percolation tanks are used for supplemental irrigation.

Farm ponds : These are small storage structure for collection and storage of runoff water. A portion of the excess runoff water after allowing maximum in situ moisture conservation is collected in farm ponds. As far as possible the pond should be located in lower patches of

...ge to facilitate better storage and less seepage losses. ... worked out considering annual rainfall, probable runoff and the catchment area. There are three types of excavated farm ponds Square, rectangular and circular. Circular ponds have high water storage capacity. Farm pond of size 100 to 300 m^3 may be dug to store 50 % of run off. The problem associated with farm ponds in red soils in high seepage loss. This can be reduced by lining walls. Some of the traditional methods for seepage control are the use of bentonite, soil dispersant and soil cement mixture. Bentonite has excellent sealing properties if kept continuously wet, but cracks develop when dried.

Inter-row water harvesting : In areas of high rainfall, there is possibility for occasional waterlogging and yield of crop like maize is affected. Growing of maize on bed and rice in furrows helps in increasing the yield of both the crops. The excess water is collected on beds is stored in furrows which is beneficial for rice.

Broad bed furrows (BBF): This practice has been recommended by ICRISAT for vertisole or black soil in high rain fall areas(>750 mm). Here beds of 90- 120 cm width, 15 cm height and convenient length are formed, separated by furrows of 60 cm width and 15 cm depth. When runoff occurs, its velocity will be reduced by beds and infiltration opportunity time is increased. Crops are sown on the broad beds and excess water is drained through number of small furrows which may be farm ponds where the water can be stored for subsequent use.

Q.3 Define drought. Give classification of drought and explain Agriculture drought. 8m

ANS:- Drought is defined as prolonged period without rainfall. OR Drought is a situation when the actual seasonal rainfall is deficient by more than twice the mean deviation. OR Drought as a situation occurring in any area where the annual rainfall is less than 75% of normal rainfall.

Drought can be classified based on,

Based on duration

a) Permanent droughtb) Seasonal drought c) Contingent drought: d) Invisible drought:.

Based on relevance to the users

a) Meteorological drought b) Atmospheric drought c) Hydrological drought

d) Agricultural drought.

Based on time of occurrence

a) Early season drought b) Mid season drought c) Late season drought

Other terms to describe drought

a) Relative drought b) Physiological drought

Agricultural drought (soil drought): It is the result of soil moisture stress due to imbalance between available soil moisture and evapotranspiration of a crop. It is usually gradual and progressive. Plants can therefore, adjust at least partly, to the increased soil moisture stress. This situation arises as a consequence of scanty precipitation or its uneven distribution both in space and time. It causes yield loss depends on the crop growth stage and the degree of stress. It does not begin when the rain ceases, but actually commences only when the plant roots are not able to obtain the soil moisture rapidly enough to replace evapotranspiration losses

Important causes for agricultural drought are

- Inadequate precipitation
- Erratic distribution of rainfall
- Long dry spells in the monsoon
- Late onset of monsoon
- Early withdrawal of monsoon
- Lack of proper soil and crop management

Q.4 What is rainfed agriculture? What are the limitations associate with production under rainfed area in india 4M

ANS:-Rainfed agriculture refer as rain dependent agriculture, where the management of soil and growing of crops under natural precipitation or rainfall, without any irrigation.

Constraints of rainfed agriculture in india.

A Monsoon constraints

1. Rainfall variation
2. Intensity and distribution
3. Late onset of monsoon
4. Early withdrawal of monsoon
5. Prolong dry spells
6. Frequent droughts due to low & erratic rainfall

B Soil constraints

Undulating topography
Shallow soil depth
Low fertility due to low organic matter , Low N & P availability.
Poor crop growth unreliable moisture stress.
Degradation soil erosion with poor fertility
Soil erosion and runoff
Over exploitation of ground water.

C Constraints of farming.

Improper soil and water conservation practices
Shallow and along the slop tillage
Inadequate crop rotation
Lack of organic matter recycling
Untimely sowing and poor crop growth.
Using long duration and low yielding varieties.
Improper seed rate
Lack of inter-cultivation and weed management
Extensive climatic hazards such as weather aberrations , drought, flood, low fertile and productivity of soils, frost, cyclones etc.

D Socio-economic constraints

Small holding and high population pressure.
Unemployment for most of the year.
Low cropping intensity and low income.
Low literacy
Lack of low draft power
Lack of subsidiary enterprises
Lack of vegetative cover

E Technological constraints

Lack of suitable genotype giving high and stable yield
Limited scope of land improvement, etc.

Q.5 Define watershed. Enlist different principles of watershed management.

ANS.- Watershed :- Watershed is a drainage area [illegible] precipitation reach a particular point called common outlet. It is a land surface bounded by a divide, which contribute runoff to common point.

Principles of watershed management are..

1. Utilizing the land according to its capability.
2. Protecting top fertile soil.
3. Conserving as much rain water as possible at the place where it falls.
4. Minimizing the silting of tanks, reservoirs and lower fertile land.
5. Protecting vegetative cover throughout the year.
6. Draining out excess water and diverting it to storage pond and store it for future use.
7. Avoiding gully formation and putting checks at suitable interval to control soil erosion and recharge ground water.
8. Increasing cropping intensity through intercropping and sequence cropping.
9. maximizing productivity for unit time per unit water.
10. Safe utilization of marginal land through alternate land use system.
11. Maximizing farm income through agricultural activities such as dairy, poultry, sheep and goat farming.
12. Setting up of small scale agro-industries.
13. Improving socio-economic status of farmers

Q.6 Define term antitranspirant. Describe different types of antitranspirants. 4 M

ANS:- Antitranspirant is any material applied to transpiring plant surface for reducing water loss from the plant.

Types of Antitranspirants

i) Stomatalclosing : Most of the transpiration occurs through the stomata on the leaf surface. Some fungicides like phenyl mercuric acetate (PMA) and herbicide atrazine in low concentration serve as antitranspirants by inducing stomata closing. This might reduce the photosynthesis also simultaneously. PMA was found to decrease transpiration to a greater degree than photosynthesis in number of plants.

ii) Film forming : Plastic and waxy materials which from a thin flim on the leaf surface retard the escape of water due to formation of physical barrier. Mobile- hexadeconal, silicon are some of the film forming type of antitranspirants.

iii) Reflectants : There are white materials which from a coating on the leaves and increase the leaf reflectance. By reflacting the radiation, they reduce leaf temperature and vapour pressure gradient from leaf to atmosphere and thus reduce transpiration. Application of 5% Kaolin spray reduces transpiration losses.

iv) Growth retardants : These chemicals reduce shoot growth and increase root growth and thus enable the plant to resist drought. They may also induce stomata closure, Cycocle is one such chemical useful for improving water status of the plant e.g. Cycocel (CCC), Phosphon-D, Maleic Hydrazide (MH).

4M

Q.7 Explain in brief Crop adaptation to drought.

ANS:-The ability of crop to grow satisfactorily under water stress is called drought adaptation. Adaptation is structural or functional modification in plants to survive and reproduce in a particular environment.

Crops survive and grow under moisture stress conditions mainly by two ways:

(i) escaping drought and (ii) drought resistance

Escaping Drought

Evading the period of drought is the simplest means of adaptation of plants to dry conditions. In cultivated crops, the ability of a cultivar to mature before the soil dries is

of the main adaptation to growth in dry regions. In rainfed areas short duration pulses like cowpea greengram, blackgram can be included in this category.

Drought Resistance

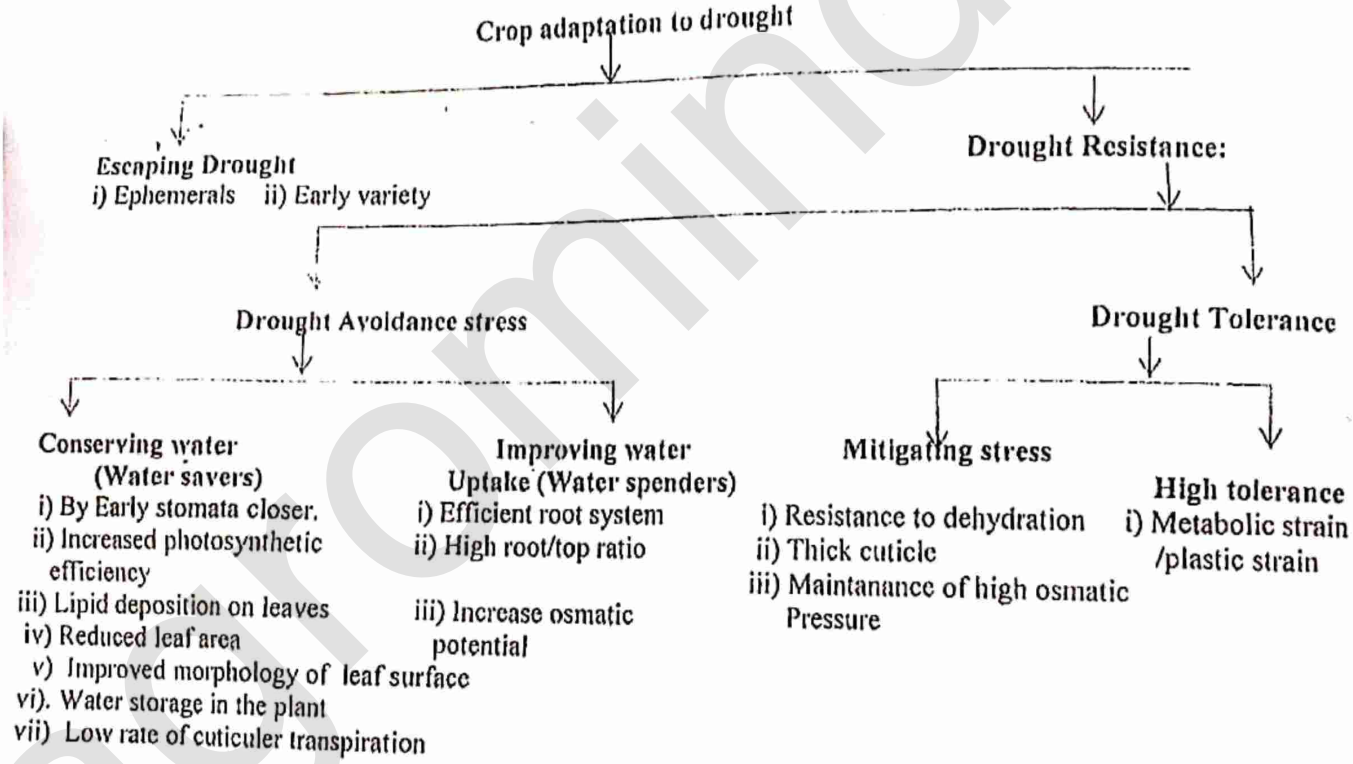
Plants can adopt to drought either by avoiding stress or by tolerating stress due to different mechanisms. These mechanisms provide drought resistance.

Drought avoidance

Stress/ drought avoidance is the ability to maintain a favourable water balance, and turgidity even when exposed to drought conditions, thereby avoiding stress and its consequences. A favourable water balance under drought conditions can be achieved either by: (i) conserving water by restricting transpiration before or as soon as stress is experienced; or (ii) accelerating water uptake sufficiently so as to replenish the lost water.

Drought Tolerance

Plant can tolerate drought is either by mitigating stress or by showing high degree of tolerance to stress. Mitigating the stress by resistance to dehydration and preventing leaf collapse permit the plant to maintain ahigh internal water potential in spite of drought conditions. Tolerating stress by resistance to metabolic strain or plastic strain during drought can increased the ability to resist and survive under condition of soil moisture stress.



Q.8 Write the important events in the history of rainfed agriculture. 4 M

ANS:-

History of rainfed Agriculture

1880 The first famine commission was appointed to suggest preventive measures to tackle drought and to suggest prevent measures to avoid famines.

1923 Establishment and dry farming research station at manjari, Pune. A systematic research work was started.

1933 Dry farming research at bijapur and solapur as approach for systemic research work on different aspects of crop production under rainfed condition.

1933-1943 Package of practices was developed for better production under rainfed conditions

1953- Establishing Central Soil Conservation Board
1954 Conservation Centers established by ICAR
1970 23 AICRPDA centers was started by ICAR
1972 Establishing International Crop Research Institute for Semi-arid Tropics (ICRISAT)

1983 Starting of 47 model watersheds under ICAR
1985 Birth of Central research Institute for Dryland Agriculture (CRIDA), Hyderabad.
1986 Launching of NWDPRA (National watershed development programme for rainfed Area) programmes by Government of India in 15 states.
1990 Launching of NWDPRA (National watershed development programme for rainfed Area) programs by Government of India covering 99 district in 16 states.
2009 Integrated watershed management program (IWMP) adopted a programs focusing for cluster of micro-watershed(1000 to 5000 ha scale)

Q.9 Suggestcrop management options to mitigate the adverse effect of aberrant weather conditions. 4M

ANS:-1) Delayed onset of monsoon

i) Alternate crop/ Varieties/ Cropping pattern

Certain crop and varieties can perform better even if sown late in the season, e.g. Castor variety Aruna is more remunerative in red soils of Telanghana than pigeon pea under late sown conditions. Sunflower, because of its shorterduration , performs better than groundnut when sowing are delayed beyond month of Sept. first fortnight in relatively deeper red soils.

ii) Transplanting

Seedling are raised in the nursery under irrigation and transplanting is after receipt of rain e.g. Rice, bajra, Finger millets are well adopted to transplanting.

2) Good start of monsoon.

Common situation, usually one or two dry spells are noticed

i) Resowing
ii) Reduce plant density
iii) 2 % urea spray
iv) Mulching
v) Increase frequency of intercultivation.
vi) Stripping of leaves
vii) Weed control
viii) Protective irrigation
ix) Use of antitranspirant like koline spray.

3) Early with-drawl of monsoon

Early withdrawal before rabi seeding leads to problem of crop stand establishment and terminal drought. Under such situation use of life saving irrigation, creation of soil mulch, lower plant population, use short duration varieties. Or

i) Sowing of rabbi crop is suspended
ii) When rabbi crop is sown, requires moisture conservation practices.

4) Extended monsoon

i) Double cropping
ii) Sowing of rabi crop may be extended .
iii) It is usual experiences that extended monsoon results in cool spell. To combat the cool spell, sorghum may require replacement in certain cases Gram and wheat may find place under such circumstances. Hence, In certain area, sorghum crop may be replaced by gram and wheat.

Q.10 Write short notes (Any two)
:) Dry land farming and rainfed farming.

Dry land Farming :

Cultivation of crops in region with annual rainfall more than 750 mm but less than 1150 mm. In spite of prolonged dry spell crop failure is less frequent. High evapotranspiration (ET) than total precipitation is the main reason for moisture deficit in this area. These are semi-arid tracts with growing period between 75 to 120 days. Moisture conservation practices are necessary for crop production. Single cropping or intercropping is followed.

Rainfedfarming :

Crop production in regions with annual rainfall more than 1150 mm. Crop are not subjected to soil moisture stress during crop period and there are less chances of crop failure. Emphasis is often on disposal of excess of water. These are the humid regions with growing period more than 120 days. Intercropping or double cropping is followed.

2) package of practice for management of crops in rainfed areas.

1. Deep tillage once in three years for soil and moisture conservation.
2. Optimum time of sowing to make maximum use of LGS so that crop do not encounter stress during critical stages and to avoid insect, pest and diseases cycle.
3. Selection of short duration improved high yielding varieties. Drought tolerant, resistance or drought escaping varieties and making maximum water use efficiency (WUE), less water requirement are preferably chosen. Crop planning according to length of growing (LGS) season.
4. Sowing of the crop always maintained on proper sowing time. Early sowing advantages as better yield, good seedling vigour, longer growing season prevents the attack of insect pest diseases. Ideal plant population is essential for anideal crop yield with Row spacing, planting patterns, densities, configuration, plant row orientation are taken care of.
5. Under Nutrient management Adequate dose, at suitable time as per recommendation are used to increase yield.The nutrient can be supplied through bulky organic manures also.
6. Efficient cropping system e.g. Mixed cropping, intercropping, double cropping as required are used for getting maximum return from rainfed farming.
7. Integrated weed control and intercultural operations
8. In situ moisture conservation &Use of protective or minimal irrigation
9. Crop planning for aberrant weather.
10. Plant protection measures
11. Use of contingency crop planning
12. Use of alternate land use

3) Factors affecting watershed management

a) Size & shape of the watershed :- Size of watershed determines the quantity of rainfall received retained and disposal off. Larger the watershed, larger be the channeland storage of water in basin. Watershed may have several shapes like square, triangular, rectangular, oval, palm fern leaf shape etc. The length: width ratio which in turn has a great effect on runoff disposal.

b) Topography :- Slop, length, degree and uniformity of slop affect both disposal of water and soil loss. Degree and length of slop also affect time of concentrations and infiltration of water.

Soil and their characteristics :- Physical and chemical ... and structure and soil depth influence disposition of wate... ways of infiltra... runoff.

d) Precipitation :- Rain provides incoming precipitation along with its various characteristic like intensity, frequency and amount of rainfall.

e) Land use pattern :- Type of land use, its extent and management are the key factor which affect watershed behavior.

f) Vegetative cover :- Depending upon the type of vegetation and its extent, this factor regulates the functioning of watershed.

g) Social status of inhabitability

h) Water resource and their capabilities

SECTION " B"

Q.11Explain, Term 4M.

1) Mulching is the practice of covering the soil surface with organic or other materials such as straw, grass, stones, plastic etc. to reduce evaporation, weed density and also to moderate diurnal soil temperature.
2) Growing of two or more crops on same piece of land with distinct row pattern is called Intercropping.
3) Plants complete their life cycle before water stress is called Ephemerals.
4) Vegetative barriers are closely planted grass or shrub rows along the contour for erosion control in agricultural lands. They check the velocity of runoff and retain the sediment by acting as barrier to runoff.

Q.12 Fill in the blanks 4M

1) **Contourbunding** is suitable for moisture conservation in low rainfall area.
2)Broad bed furrow is evolved by an institute, situated at **Hyderabad.**
3) Maharashtra receives 95 percent of its annual rainfall from the **South-West** monsoon.
4)**Vertisols** soils are black soft with high clay content (30-70%) undergo pronounced shrinkage during drying, resulting in large cracks.

Signature of Course Instructor

Name:- Dr. M.D. Yenpreddiwar,
Assistant professor
College Of Agriculture, Gadchiroli.
Mob.no :- 9422179297

Signature of University Head of the Department

Name: -Dr. A.N.Paslawar
Head,
Department Of Agronomy,
Dr. PanjabraoDeshmukhKrishiVidyapeeth, Akola
Mob. No. 9822220272