Seeds - Seed rate - Sowing methods - Germination - Crop stand establishment - Planting geometry

SEEDS

Plant propagation is made in two ways, Sexual (by seeds) and asexual (by vegetative means). Biologically, seed is a ripe, fertilized ovule and a unit of reproduction of flowering plants.

SEED RATE

The required number of plants/unit area is decided by calculating the seed rate. The seed rate depends on spacing or plant population, test weight, germination percentage. The formula is as follows.

$$\text{Seed rate (kg/ha)} = \frac{\text{Plant population (per ha) x No. of seeds/hill x Test weight (g) x 100}}{\text{1000 x 1000 x Germination percentage (\%)}}$$

SOWING METHODS

1. Broadcasting
2. Dibbling
3. Sowing behind the country plough (manual and mechanical drilling)
4. Seed drilling
5. Nursery transplanting

1. Broadcasting

Broadcasting is otherwise called as random sowing. Literally means 'scattering the seeds'. Broadcasting is done for many crops. Broadcasting is mostly followed for small sized to medium sized crops. This is the largest method of sowing followed in India, since; it is the easiest and cheapest and requires minimum labours. To have optimum plant population in unit area certain rules should be followed.

- Only a skilled person should broadcast the seeds for uniform scattering.
- The ploughed field should be in a perfect condition to trigger germination.

The seeds are broadcasted in a narrow strip and the sowing is completed strip by strip. To ensure a good and uniform population, it is better to broadcast on either direction. This is called criss-cross sowing. If the seed is too small, it is mixed with sand to make a bulky one and for easy handling. Ex. Seasame seeds are mixed with sand at 1:15 or 1:10 ratio and sown.

In certain cases the person sowing will be beating the seeds against the basket for uniform scattering. Ex. Sorghum, pearl millet.

After broadcasting, the seeds are covered gently either using a country plough with a very shallow ploughing or some wooden planks (boards / levelers) are used to cover the surface. In some cases, tree twigs or shrub branches are used. If the seeds are large, levelers collect the seeds and leave in the other side. Comb harrow is the best used one.

Disadvantages

- All the seeds broadcasted do not have contact with the soil. 100% germination is not possible.
- Enhanced seed rate is required.
- Seeds cannot be placed in desired depth. Desired depth ensures perfect anchorage. Lodging (falling down) is common in broadcasting.

2. Dibbling

This is actually line sowing. Inserting a seed through a hole at a desired depth and covering the hole. Dibbling is practiced on plain surface and ridges and furrows or beds and channels. This type of sowing is practiced only under suitable soil condition. Rice fallow cotton is dibbled on a

plain surface. The seeds are dibbled at 2/3rd from top or 1/3rd at bottom of the ridge. Before sowing, furrows are opened and fertilizers are applied above which seeds are sown. The seeds do not have contact with the fertilizers. This is done for wider spaced crops and medium to large sized seeds. Ex. Sorghum, maize, sunflower, cotton are dibbled on ridges and furrows. Both beds and channels; and ridges and furrows come under line sowing. While earthing up, the plant occupies middle of the ridge. Earthing up is essential for proper anchorage of the root system.

Advantages of line sowing are, (i) uniform population, (ii) better germination, (iii) reduced seed rate.

Sl. No.	Dibbling (Line sowing)	Broadcasting (Random sowing)
1.	Costlier	Cheaper
2.	Takes considerable time	Quickest and time saving
3.	Fixed seed rate	Higher seed rate
4.	Mechanization is possible, e.g. weeding, harvesting	Not possible
5.	Uniform utilization of resources (land, water, light, nutrient, etc.)	Resource utilization is un-uniform

3. Sowing behind the plough

Sowing behind the plough is done by manual or mechanical means. Seeds are dropped in the furrows opened by the plough and the same is closed or covered when the next furrow is opened. The seeds are sown at uniform distance. Manual method is a laborious and time consuming process. Seeds like redgram, cowpea and groundnut are sown behind the country plough. Major sown crop is ground out. Seeds are sown by mechanical means by Gorus – seed drill. A seed drill has a plough share and hopper. Seeds are placed on hopper. Different types of seed drill are available, e.g., simple Goru – Guntakas.

Advantages: i) The seeds are placed at desired depth covered by iron planks, ii) except very small, very large seeds most of the seeds can be sown, e.g. maize, sorghum, millets, sunflower, etc.

4. Drill sowing (or) Drilling

Drilling is the practice of dropping seeds in a definite depth covered with soil and compacted. In this method, sowing implements are used for placing the seeds into the soil. Both animal drawn Gorus and power operated (seed drills) implements are available. Seeds are drilled continuously or at regular intervals in rows. In this method, depth of sowing can be maintained and fertilizer can also be applied simultaneously. It is possible to take up sowing of inter crops also. It requires more time, energy and cost, but maintains uniform population per unit area. Seeds are placed at uniform depth, covered and compacted.

5. Transplanting

This method of planting has two components, a. nursery and b. transplanting. In nursery, young seedlings are protected more effectively in a short period and in a smaller area. Management is easy and economical.

Advantages

- Can ensure optimum plant population
- Sowing of main field duration, i.e., management in the main field is reduced
- Crop intensification is possible under transplanting

Disadvantages

- Nursery raising is expensive
- Transplanting is another laborious and expensive method

Age of seedlings is 1/4th of the total duration of the crop. If the total duration is 16 weeks, four week period (1 month) is under nursery beds. Nursery age is not very rigid, e.g., thumb rule – 3 months crop – nursery duration 3 weeks, minimum 4 months – 4 weeks minimum period; 5 months

– 5 weeks. After the nursery period, seedlings are pulled out and transplanted. This is done on the main field after thorough field preparation or optimum tilth. The seedlings are dibbled in lines or in random. Closer spaced crops are mostly raised in random method even after nursery, Ex. rice and finger millet. For vegetables, desired spacing is required during transplanting. Transplanting shock is a period after transplanting, the seedlings show no growth. This is mostly due to the change in the environment between root and the soil. The newly planted seedlings should adjust with new environment. It is for a period of 5-7 days depending upon season, crop, variety, etc. At higher temperature, dehydration is possible and leaves dried out. Area required for nursery normally is $1/10^{th}$ of the total area.

GERMINATION

- Germination is a protrusion of radicle or seedling emergence.
- Germination results in the rupture of the seed coat and emergence of seedling from embryonic axis.

Factors affecting seed germination

1. Soil: Soil type, texture, structure and microorganisms greatly influence the seed germination.
2. Moisture: When the seeds do not get required moisture in the soil, the viability is lost. When the moisture is excess after germination, it will lead to rotting of the sprouts.
3. Temperature: When it is above and below the optimum temperature, the germination rate will be affected.
4. Light: The most effective wavelength for promoting germination is red (662 nm) and 730 nm inhibits germination.
5. Soil condition: a. Tilth is the most important soil factor influences on germination of seed. Small seeds require fine tilth whereas, moderate and larger seeds requires medium and coarse tilth soils, respectively.

   b. Depth of sowing: The seeds should be placed at optimum depth. When the seeds are placed at deeper layers they have to spend more energy for germination. When it is placed on soil surface, it will be taken away by birds/worked away. The thumb rule is to sow seeds to a depth of approximately 3 to 4 times diameter of the seed. The optimum depth of sowing for most of the field crops ranged between 3 and 5 cm depth. The seeds sown should be protected from rodents or birds before germination by employing labourers to scare the birds at least for three days after sowing.

CROP STAND ESTABLISHMENT

Good crop establishment is one of the most important features in better crop production. The better crop establishment is in turn expressed as optimum plant population in fields. Number of plants per unit area in the cropped field is called as plant population.

Optimum plant population

It is the number of plants required to produce maximum output or biomass per unit area. Any increase beyond this stage results in either no increase or reduction in biomass.

Importance of plant population

- Yield of any crop depends on final plant population.
- The plant population depends on germination percentage and survival rate in the field.
- Under rain fed conditions, high plant population will deplete the soil moisture before maturity, where as low plant population will leave the soil moisture unutilized.
- When soil moisture and nutrients are not limited high plant population is necessary to utilize the other growth factors like solar radiation efficiently.
- Under low plant population, individual plant yield will be more due to wide spacing.

- Under high plant population, individual plant yield will be low due to narrow spacing leading to competition between plants.
- Yield per plant decreases gradually as plant population per unit area is increased, but yield per unit area increases up to certain level of population. That level of plant population is called as optimum population.
- So, to get maximum yield per unit area, optimum plant population is necessary. So the optimum plant population for each crop should be identified.

Factors affecting plant population

A. Genetic Factors

1. Size of the plant

- The volume occupied by the plant at the time of flowering decides the spacing of the crop.
- Plants of red gram, cotton, sugarcane etc. occupy larger volume of space in the field compared to rice and wheat.
- Even the varieties of the same crop differ in size of the plant.

2. Elasticity of the plant

- Variation in size of the plant between minimum size of the plant that can produce some economic yield to the maximum size of the plant that can reach under unlimited space and resources is the elasticity of the plant.
- The optimum plant population range is high in indeterminate plants. Ex. Redgram – 55,000 to1,33,000 plants/ha.
- The elasticity is due to tillering and branching habit of the plants.
- For determinate plants like pearl millet, sorghum elasticity range is less.
- For indeterminate plants like cotton and Redgram, more branches will be produced by the crop.

3. Foraging area or soil cover

- Crop should cover the soil as early as possible so as to intercept maximum sunlight.
- Higher the intercepted radiation more will be the dry matter produced.
- Close spaced crops intercept more solar radiation than wide spaced crops.

4. Dry matter partitioning

- Dry matter production is related to amount of solar radiation intercepted by the canopy which depends on plant density.
- As the plant density increases, the canopy expands more rapidly, more radiation is intercepted and more dry matter is produced.

5. Crop and variety

Depending on the crops and varieties, the plant population varies.

Rice :	Short duration	-	6,66,666 plants/ha (15 cm x 10 cm)
	Medium	-	5,00,000 plants/ha (20 cm x 10 cm)
	Long	-	3,33,000 plants/ha (20 cm x 15 cm)
Cotton :	Medium	-	55,555 plants/ha (60 cm x 30 cm)
	Long	-	44444 plants/ha (75 cm x 30 cm)
	Hybrids	-	18,518 plants/ha (120 cm x 45 cm)
Maize :	Varieties	-	83,333 plants/ha (60 x 20 cm)
	Hybrids	-	47,620 plants/ha (60 x 35 cm)

B. Environmental factors

1. Time of sowing

- The crop is subjected to various weather conditions when sown at different periods.

- Among weather factors, day length and temperature influence much on the plant population. As low temperature retards growth, high plant population is required to cover the soil.

2. Rainfall / irrigation

1. Plant population has to be less under rainfed than irrigated condition.
2. Under more plant densities, more water is lost through transpiration.
3. Under adequate rainfall / irrigation, high plant population is recommended.

3. Fertilizer application

1. Higher plant population is necessary to fully utilize higher level of nutrients in the soil to realize higher yield.
2. Nutrient uptake increases at optimum plant population.
3. High population under low fertility soils leads to nutrient deficiency symptoms leading low yield.

4. Seed rate

- Quantity of seed sown/unit area, viability and establishment rate decides the plant population. Under broadcasting the seed rate is higher when compared with line sowing/transplanting, Ex. Rice.

  Direct sowing - 100 kg/ha; Line sowing - 60 kg/ha; Transplanting - 40 kg/ha.

PLANT GEOMETRY

The arrangement of the plants in different rows and columns in an area to utilize the natural resources efficiently is called crop geometry. It is otherwise area occupied by a single plant Ex.. Rice – 20 cm x 15 cm. This is very essential to utilize the resources like light, water, nutrient and space. Different geometries are available for crop production

Different crop geometries are available for crop production

1) Random plant geometry

Random plant geometry results due to broadcasting method of sowing and no equal space is maintained. Resources are either under utilized or over exploited.

2) Square plant geometry

The plants are sown at equal distances on either side. Mostly perennial crops, tree crops follow square method of cultivation. Ex. Coconut – 7.5 x 7.5 m; banana – 1.8 x 1.8 m. But, due to scientific invention, the square geometry concept is expanded to close spaced field crops like rice too.

Advantages

Light is uniformly available, movement of wind is not blocked and mechanization can be possible.

3) Rectangular method of sowing

There are rows and columns, the row spacing are wider than the spacing between plants.

The different types exist in rectangular method are,

a) Solid row: Each row will have no proper spacing between the plants. This is followed only for annual crops which have tillering pattern. There is definite row arrangement but no column arrangement, Ex. Wheat.

b) Paired row arrangement: It is also a rectangular arrangement. It a crop requires 60 cm x 30 cm spacing and if paired row is to be adopted the spacing is altered to 90 cm instead of 60 cm in order to accommodate an intercrop. The base population is kept constant.

c) Skip row: A row of planting is skipped and hence there is a reduction in population. This reduction is compensated by planting an intercrop; practiced in rainfed or dryland agriculture.

d) Triangular method of planting: It is recommended for wide spaced crops like coconut, mango, etc. The number of plants per unit area is more in this system.