Study on the Calculation of Seed Rates

Mirza Hasanuzzaman, PhD
Professor
Department of Agronomy
Sher-e-Bangla Agricultural University
E-mail: mhzsauag@yahoo.com

Definition

Seed rate is the quantity of seed of a crop that is required to sow a unit area of land for optimum crop production.

Importance of determining seed rate

- To maintain optimum plant population in the field for higher yield harvest.
- To prevent seed wastage from excess sowing such reduces the initial cost of production.
- To know the quantity of seed needed for sowing in advance.
- To ensure quality crop production.

Factors affecting seed rate

Desired plant population per unit area (DPP/UA)

It is the number of plants expected in a unit area of land for optimum crop production. It varies from crop to crop and depends upon some factors: growing season, soil productivity, sowing time and method of cultivation etc.

Number of seed per hill or pit (NS/H or NS/P)

In case of maize, cotton etc. 2-3 seeds are kept in a hill or pit and after the seedling germination only the healthy seedling is kept while others are discarded. In such case the seeds used in a hill affect directly on seed rate.

Purity percentage (PP)

It determines the percentage of pure seed present in a seed lot, which in turn determines the number of plants in a unit area. Seed rate increases or decreases with decreases or increases of purity percentage respectively.

Germination percentage (PG)

It is the number of normal seedlings out of 100 seeds, placed for germination test. Seed rate changes with the changes of germination percentage of a crop.

Percentage of safety allowance or field factor (PSA/FF)

It is the extra amount of seeds used during sowing, to ensure the desired plant population in the field against any seed loss that occurs after sowing. This loss may be happened due to moisture, status of soil, depth of sowing, intensive vertebrate attacks. The percentage of safety allowance varies with the changes of safety allowances.

Weight of thousand seeds (WTS)

It is weight of one thousand seed. It depends on the plumpness and moisture content of seed. The weight of seed (kg or lb) required for a unit area of land is determined based on weight varies from crop to crop. Seed rate changes proportionally with the seed size/weight.

B. Indirect factors

Other than direct factors, the following factors are also responsible indirectly to determine seed rate of any crops.

Soil fertility and productivity: Poor/infertile soils require low seed rate because crops are widely spaced compared to fertile soils.

Growth characteristics of the crop: Tall/tillering/indeterminate varieties require low seed rate compared to short/ less tillering/determinate varieties. e.g. for BARI maize varieties *Suvra*, *Mohor* and *Barnali*, the seed rate is 25-30 kg ha^{-1} while the seed rate for *Khoi Vutta* is 15-20 kg ha^{-1}. For desi jute the seed rate for broadcasting system is 8-10 kg ha^{-1} while the seed rate tossa jute is 6-8 kg ha^{-1}.

Spacing: High seed rate is required in closer spacing than wider spacing.

Number of seeds per hole: Two or more seeds per hole requires more seed rate than one seed per hole.

Intended use of the crop: e.g. fodder maize requires high seed rate than grain maize.

Growing season: Rainfed season requires more seed rate than irrigated season.

Method of planting: Broadcasting requires high seed rate than row planting. According to BARi recommendation, hand sown wheat seeds required a rate of 120 kg ha^{-1}, while BARI seeder and bed planter needs only 100 kg seeds ha^{-1} (BARI 2015).

Pure/mixed stand: High seed rate for pure stand and low seed rate for mixed stand.

Planting time: Late planting requires more seeds.

Calculation of seed rate

Seed rates can be determined by the following formula:

A. Seed rate (kg ha^{-1}) = $\frac{10\left(\mathrm{DPP}+\frac{\mathrm{DPP}\times\mathrm{PSA}}{100}\right)}{\mathrm{PP}\times\mathrm{PG}\times 1000}\times \mathrm{WTS\ (g)}$

B. Seed rate (lb ac^{-1}) = $\frac{10\left(\mathrm{DPP}+\frac{\mathrm{DPP}\times\mathrm{PSA}}{100}\right)}{\mathrm{PP}\times\mathrm{PG}\times 453.6}\times \mathrm{WTS\ (lb)}$

The above formulae have many limitations and are seldom used.

C. SR (g ha^{-1}) = $\frac{\mathrm{DPP/ha}\times\mathrm{NS/H}\times\mathrm{ISW}\times\mathrm{MF}}{\mathrm{PP}\times\mathrm{PG}\times\mathrm{FF}}$

D. For dibbling and discontinuous line sowing of vegetative planting materials:

SR_{ddp} (g ha^{-1}) = $\frac{\mathrm{DNH/ha}\times\mathrm{NS/H}\times\mathrm{ISW\ (g)}}{\mathrm{PP}}$

E. For transplanting system:

SR_t (g/ha) = $\frac{\mathrm{DNH/ha}\times\mathrm{NS/H}\times\mathrm{ISW\ (g)}}{\mathrm{PP}\times\mathrm{PG}\times\mathrm{FF}}$

F. For broadcasting or continuous line sowing:

SR_{bc} (g/ha) = $\frac{\mathrm{DPP/ha}\times\mathrm{ISW\ (g)}\times\mathrm{MF}}{\mathrm{PP}\times\mathrm{PG}\times\mathrm{FF}}$

Where,

DPP = Desired plant population
PSA = Percentage of safety allowance
PP = Purity percentage
PG = Germination percentage
WTS = Weight of thousand seeds
ISW = Individual seed weight
DNH/ha = Desired number of hill/ha
NS/hill = Number of seedling/hill
MF = Method factor
DNH = area/spacing
RVS = Real value of seed
PLS = PP×PG/100

Some Problems of Seed Rate

Problem# 1.
A crop was transplanted in one hectare of land maintaining spacing 25 cm × 15 cm using 3 seedlings in each hill. The PP, PG, FF and ISW of the supplied seed were 90%, 80%, 85% and 0.04g, respectively. How much seeds will be required for 25 m × 20 m of land?

We know,

The seed rate in transplanting system, SRt (g ha^{-1}) = $\frac{\mathrm{DNH/ha}\times\mathrm{NS/H}\times\mathrm{ISW\ (g)}}{\mathrm{PP}\times\mathrm{PG}\times\mathrm{FF}}$

Here,

DNH/ha = $\frac{\mathrm{Area}}{\mathrm{Spacing}}$

= $\frac{10000\ \mathrm{m^2}}{(0.25\times 0.15)\ \mathrm{m^2}}$ = 266666 [1 m = 100 cm; 1 ha = 10000 m^2]

$$\text{Seed rate} = \frac{266666 \times 3 \times 0.04}{0.9 \times 0.8 \times 0.85}$$

$$= 52287 \text{ g ha}^{-1}$$

$$= 52.287 \text{ kg ha}^{-1}$$

Required quantity of seeds for 25m × 20m of land = 52.287 kg × $\frac{(25 \times 20)\ m^2}{10000\ m^2}$ = **2.61 kg**

Problem# 2.
A seed lot having 90% PP, 85% PG and weight of individual seed is 0.03 g. If the desired plant population is 2,66,666 and field factor is 85%, calculate the seed rate for line sowing system when method facto is 3.

$$\text{SRbc (g/ha)} = \frac{\text{DNH/ha} \times \text{ISW (g)} \times \text{MF}}{\text{PP} \times \text{PG} \times \text{FF}}$$

$$= \frac{266666 \times 0.03 \times 3}{0.9 \times 0.8 \times 0.85}$$

$$= 39215.58 \text{ g}$$

$$= \textbf{39.21 kg} \text{ [1 kg = 1000 g]}$$

Problem# 3.
Suppose you want to produce maize maintaining dibbling spacing of 60 cm × 30 cm where PP, NS/H and ISW are 90%, 2 and 0.2 g, respectively. How much seeds do you need for 60 m × 30 m land?

We know,
For dibbling and discontinuous line sowing systems:

$$\text{SRddp (g/ha)} = \frac{\text{DNH/ha} \times \text{NS/H} \times \text{ISW (g)}}{\text{PP}}$$

Here,

$$\text{DNH/ha} = \frac{\text{Area}}{\text{Spacing}}$$

$$= \frac{10000\ m^2}{(0.60 \times 0.30)\ m^2} = 55555 \text{ [1 m = 100 cm; 1 ha = 10000 m}^2\text{]}$$

$$\text{Seed rate} = \frac{55555 \times 2 \times 0.2}{0.9}$$

$$= 24691 \text{ g ha}^{-1}$$

$$= 24.69 \text{ kg ha}^{-1}$$

Required quantity of seeds for 60 m × 30 m of land = 24.69 kg × $\frac{(60 \times 30)\ m^2}{10000\ m^2}$ = **4.44 kg**

Problem# 4.

Suppose you want to produce hybrid rice seed keeping distances from row to row 25 cm and hill to hill 15 cm. You want to use 1 seedling per hill. The PP, PLS, FF and ISW are 95%, 90%, 80% and 0.03 g respectively. How many seeds do you need for 100 m × 50 m land?

We know,

The seed rate in transplanting system, SRt (g ha^{-1}) = $\frac{\text{DNH/ha} \times \text{NS/H} \times \text{ISW (g)}}{\text{PP} \times \text{PG} \times \text{FF}}$

Here,

DNH/ha = $\frac{\text{Area}}{\text{Spacing}}$

= $\frac{10000\ m^2}{(0.25 \times 0.15)\ m^2}$ = 266666 [1 m = 100 cm; 1 ha = 10000 m^2]

PLS = $\frac{PP \times PG}{100}$; So, PG = $\frac{PLS \times 100}{PP} = \frac{90 \times 100}{95}$ = 94.73

Seed rate = $\frac{266666 \times 1 \times 0.03}{0.95 \times 0.9473 \times 0.80}$

= 11111.88 g ha^{-1}

= 11.11 kg ha^{-1}

∴Required quantity of seeds for 100 m × 50 m of land = 11.11 kg × $\frac{(100 \times 50)\ m^2}{10000\ m^2}$

= **5.55 kg**

Problem# 5.

When PLS is 90% of a seed lot then seed rate is 50 kg ha^{-1}. After a few days the PLS is reduced to 80% of that seed lot. At this condition what will be the seed rate?

With 90% PLS the seed rate was 50 kg ha^{-1}

With 1% PLS the seed rate was 50×90 kg ha^{-1}

With 80% PLS the seed rate was $\frac{50 \times 90}{80}$ = **56.25 kg ha^{-1}**

Problem# 6.

The normal seed rate of a crop is 50 kg/ha. But if the RVS becomes 80% then what will be the seed rate?

Note: Normal seed rate is the rate when RVS is 100%

With 100% PLS the seed rate was 50 kg ha^{-1}

With 1% PLS the seed rate was 50×100 kg ha^{-1}

With 80% PLS the seed rate was $\frac{50 \times 100}{80}$ = **62.5 kg ha^{-1}**

Problem# 7.

Find out the number and weight of seed required for an area of 50 m × 10 m having row to row and plant to plant distances of 25 cm and 10 cm respectively and weight of thousand seed is 30 g.

Required number of seeds = $\frac{(50 \times 10)\ m^2}{(0.25 \times 0.10)\ m^2}$ = 20000

Weight of 1000 seeds is 30 g

Weight of single seed is $\frac{30}{1000}$ g

Weight of 20000 seeds is $\frac{30 \times 20000}{1000}$ g = **600 g**

Problem# 8.

Find out the amount of seed of 70% RVS for a plot measuring 50 m × 20 m considering seed rate 30 kg ha^{-1}, when PLS/RVS is 100%.

When RVS is 100% then seed rate was 30 kg ha^{-1}

When RVS is 1% then seed rate was 30×100 kg ha^{-1}

When RVS is 70% then seed rate was $\frac{30 \times 100}{70}$ kg ha^{-1} = 42.857 kg ha^{-1}

Required quantity of seeds for 50 m × 20 m of land = 42.857 kg × $\frac{(100 \times 50)\ m^2}{10000\ m^2}$

= **4.28 kg**

Problem# 9.

The required amount of seed potato tuber is 1.7 t ha^{-1} maintaining a spacing of 60×30 cm. If the purity of the seed is 98% what is the weight of a single tuber.
We know,

The seed rate in vegetative planting system, SR_{ddp} (g ha^{-1}) = $\frac{\text{DPP/ha} \times \text{NS/H} \times \text{ISW (g)}}{\text{PP}}$

Here, DPP/ha = $\frac{10000\ m^2}{(0.60 \times 0.30)\ m^2}$ = 55555 [1 m = 100 cm; 1 ha = 10000 m^2]

Now, 1.7 t or 1700000 g = $\frac{55555 \times 1 \times \text{ISW (g)}}{0.98}$

∴ ISW = $\frac{0.98 \times 1000000}{55555}$ = 29.988 ≈ 30 g

Problem# 10.

Sugarcane setts are planted in the center of a trench. Determine the number of setts required in an area of 500 m^2 of land when trench-to-trench distance is 120 cm, sett-to-sett distance is 15 cm and length of an individual sett is 22.5 cm. If the weight of a single sett is 100g then determine the weight of required setts in t ha^{-1}.

Required length for single sett = $(22.5 + \frac{15}{2} + \frac{15}{2})$ cm = 37.5 cm
Area required for single sett = 120 cm × 37.5 cm = 1.2 m × 0.375 m = 0.45 m^2

Number of setts required for 500 m^2= 500 m^2 ÷ 0.45 m^2 = 1111

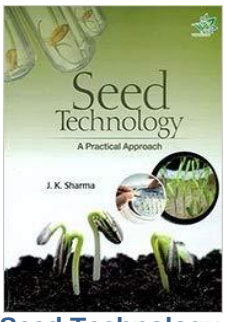
Weight of single sett is 100 g
∴Weight of 1111 setts is (100 × 1111) g = 111100 g

Setts required for 500 m^2 is 111100 g

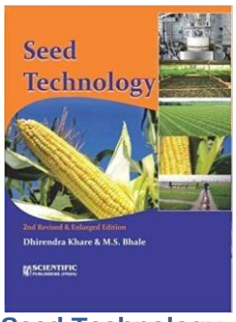
∴ Setts required for 1 ha is $\frac{111100 \times 10000}{500}$ g [1 ha = 10000 m^2]

= 2222000 g = 2222 kg = 2.22 t ha^{-1}

Suggested reading:



Seed Technology: A Practical Approach
By J.K. Sharma
Westville Publishing House (2012)



Seed Technology
By D Khare
Scientific Publishers India (2014)

Bij O Agacha
By Iqbal, T.M.T., M.A. Gaffar, M.S. Alam, M.S. Amin
BAU (2000)