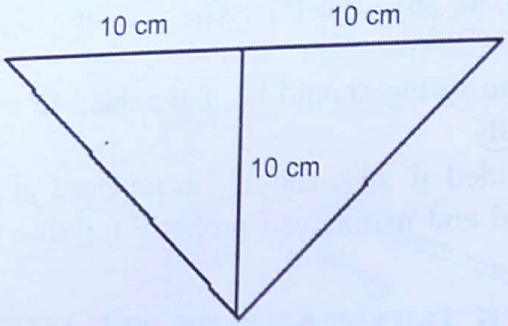
SOLVED NUMERICALS

Problem 1 A cultivator of size 11 × 30 cm is being operated at a depth of 10 cm. The shape of furrow x-section is a triangle with tip angle of 90°. Determine the draft required to pull the cultivator if unit draft for soil is 20 kN/m^2.

Solution: The shape of furrow opened by the given cultivator tine would be like a right isosceles triangle, therefore, the base will be equal to twice the depth of furrow.



Now, the area of x-section of an individual furrow would be:

$$= \frac{\text{Base} \times \text{Height}}{2}$$

$$= \frac{0.20 \times 0.10}{2}$$

$$= 0.01 \text{ m}^2$$

Draft of one tine = x-sectional area of one furrow × unit draft

$$= 0.01 \times 20$$

$$= 0.20 \text{ kN}$$

Total draft required to pull the cultivator

= Draft of one tine × number of tines

$$= 0.20 \times 11$$

$$= 2.20 \text{ kN}$$

Ans.

Problem 2 A 9 tine tractor operated cultivator having a tine spacing of 20 cm is operating at a speed of 4.50 km/h. The individual tine is making 15 cm wide and 12 cm deep furrow. The soil resistance is 0.50 kg/cm^2. Considering a time loss of 12 percent at headlands, determine the field capacity and horse power required to pull this cultivator.

Solution: Field efficiency = 100 – time lost

$$= 100 - 12$$

$$= 88 \text{ percent}$$

$$\text{Field capacity} = \frac{\text{Number of tines} \times \text{Tine spacing} \times \text{Speed of operation}}{10} \times \text{Field efficiency}$$

$$= \frac{9 \times 0.20 \times 4.50}{10} \times \frac{88}{100}$$

$$= 0.71 \text{ ha/h}$$

Total draft = Furrow x-section × soil resistance

$$= 9 \times 15 \times 12 \times 0.50$$

$$= 810 \text{ kg}$$

$$\text{Unit draft} = \frac{\text{Total draft}}{\text{Furrow } x\text{-section}}$$

$$\text{Horse power} = \frac{\text{Total draft} \times \text{Speed of operation}}{4500}$$

$$= \frac{810 \times 75}{4500}$$

$$= 13.50 \text{ hp}$$

Ans.

Problem 3 Interculture operation in sugarcane crop is required to be done having a total area of 8.50 ha. The weeding tool is having an overall width of 150 cm and is being operated at forward speed of 3.50 km/h. The time loss in turning and minor adjustments, etc. is 8 percent. Determine the field capacity of the weeder and total time required to cover the given area.

Solution:

$$\text{Field capacity} = \frac{\text{Overall width of weeding tool} \times \text{Speed of operation}}{10} \times \text{Field efficiency}$$

$$= \frac{150 \times 3.50}{10} \times \frac{92}{100}$$

$$= 0.48$$

Time required to cover 8.50 ha area

$$= \frac{8.50}{0.48}$$

$$= 17.71 \text{ hours}$$

Ans.

Problem 4 In a cotton field, the following observations were recorded while performing weeding operation with a power weeder:

(i)	Speed of operation	: 3.20 km/h
(ii)	Weed population before weeding operation	: 1500 g/m^2
(iii)	Weed population after weeding operation	: 400 g/m^2
(iv)	Effective width of operation of weeder	: 600 mm
(v)	Depth of operation	: 100 mm
(vi)	Total draft	: 680 kg
(vii)	Field efficiency of weeder	: 86 percent
(viii)	Plant damage	: 8 percent

Determine: Field capacity, power required to pull the weeder, weeding efficiency, performance index of the weeder and unit draft of the weeder.

Solution:

$$\text{Field capacity} = \frac{\text{Total width of weeder} \times \text{speed of weeder}}{10}$$

$$= \frac{0.60 \times 3.20}{10} \times 0.86 = 0.17$$

$$\text{Power required} = \frac{\text{Total draft} \times \text{speed of operation}}{4500}$$

$$= \frac{680 \times 53.33}{4500}$$

$$= 8.06$$

$$= \text{Weeding efficiency} = \frac{W_1 - W_2}{W_1} \times 100$$

$$= \frac{1500 - 400}{1500} \times 100$$

$$= 73.33$$

$$\text{PI} = \frac{\text{Field Capacity} \times (100 - \text{Damage Factor}) \times \text{Weeding Index}}{\text{Input Power}}$$

$$= \frac{0.17 \times (100 - 8) \times 73.33}{8.06}$$

$$= 142.33$$

$$\text{Unit draft} = \frac{\text{Total draft}}{\text{Furrow x-section}} = \frac{680}{60 \times 10}$$

$$= 1.13$$

Ans.