Practical Manual B. Sc. (Hons.) Agriculture

Weed Management

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Complied By

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Contents

Exercise – 1 Date……

Identification of common weeds and their characteristics

Objective

To identify the weeds

Materials

Manual on weed management, Books on Botany, Taxonomy, Weed Science, Herbaria, HB Pencil, White paper etc.

Procedure

After locating different types of weeds, study their habitat, morphology and mode of propagation. Help of books, manuals, herbaria, exhibits and other references may be taken for correct and scientific reporting of weed specimen. As you get a weed plant, make a visual observation and understand it's basic characteristics.

Observations

Make a list of all weeds and note down the salient characteristics given below :

(A) Morphology of the plant

(i) Leaf : Colour, size, shape, arrangement

(ii) Stem : Colour, size, nature (erect, prostrate, angular trailing etc.) nodes and internodes, solid, hollow, woody, tender

(iii) Branches : Branched, unbranched, pattern and arrangement

(iv) Flowers : Colour, size, type of inflorescence

(v) Roots/under ground parts : Shallow, deep, tap root, adventitious, root colour, rhizomes, nuts, bulb etc.

(vi) Juncture points : Note the colour, shape, size of any plant part like hair, ligule, auricle, glands etc. present at the joining point of stem with root, leaf with stem, inflorescence with the main stem / branch etc.

(vii) Fruits / seeds : Colour, size, shape

(viii) Special points : Nature of plant sap (milky, juicy, gum etc.) and its colour, special modification on the plant etc.

(B) Growth duration : Annual / biennial /perennial

(C) Categorization in broad groups : Grasses / sedges / broadleaf

(D) Nature : Associated, crop bound, parasitic, facultative, obligate

Results

1. Important scientific information may be tabulated as under :

Table : Identification of weeds

S.No.	Name of weed (Local/English)	Botanical name	Group	Family	Salient characteristics
1.	Bermuda grass	*Cynodon dactylon*	Narrow leaf	Poaceae	Perennial, adventitious roots, stolon

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Exercise – 2 Date……

To become familiar with mode of propagation of weeds and their occurrence

Objectives

(i) To identify weed seeds and their propagules viz., root stocks, rhizomes, stolons, tubes, bulbs, bulbils, stem, roots etc.

(ii) to recall methods of propagation and agents of weed seed dispersal,

(iii) to study various appendages which help weeds in their dissemination,

(iv) to know the importance of seeds and,

(v) to acquaint about the habitat or occurrence of weeds.

Propagation of weeds

A sound knowledge of the biology of weeds with particular reference to their propagation and dispersal behaviour is essential for planning their management.

Methods of propagation

A. Sexual reproduction/propagation through seeds

In this method, fusion of male (pollen) and the female gametes (egg) takes place to form the embryo. The majority of weeds reproduce by distinct seed formation which is prolific particularly the annuals and biennial species. Such weeds are capable of producing easily thousands of seeds per plant every season at the termination of their vegetative stage. In the perennial species, on the other hand, the viable seed production capacity is much limited. e.g. *Cyperus rotundus* and *Cynodon dactylon* produce only 40-170 seeds per plant. But there are exceptions of this generalization. The perennial weeds like *Sorghum halepense* and *Saccharum spontaneum* produce thousands of seed per plant every year in the same fashion as the annual weeds. Weed seeds (and fruits) differ widely in their shape and size as well as in their viability. Many of these can germinate immediately after harvest, whereas, others remain dormant for short or long periods/ before reviving their viability. Weedy ferns, algae and *equisetums* reproduce by spore formation.

B. Propagation through vegetative propagules

In this method, either stem or root fragments of weeds cut or detached from mother plant grow into new plants or the weeds may produce specific vegetative organs for this purpose, both above and under the ground. These modifications may be in the form of rhizomes, root stocks, runners, stolons, suckers, offsets, tubers, bulbs or bulbils. Collectively these are termed as vegetative propagules. The vegetative propagation is primarily a feature of perennial weeds which employ one or more of the above cited propagules to achieve the objective, depending upon the weed species.

Besides the perennial weeds, some annual weeds can also adopt specific propagation mechanism. Such weeds vigourate their crown buds to produce new plants when the parent plants are cut at the ground level. Carrot grass (*Parthenium hysterophorus*), *Lantana camara* and arrow weed (*Pluchea lanceolata*) are some weeds of this type.

Weeds equipped with vegetative propagation are extremely difficult to manage since their propagules are located upto 100 cm soil depth where these are not easily approachable even with deep tillage or any available herbicide. . Roots of *P. lanceolata* may hit several metres deep and remain undisturbed by any deep tillage tool. Even if shallow roots and rhizomes of weeds are reached by tillage, it only tends to fragment and disseminate them to help their further propagation. In the destruction of perennial weeds with herbicides too, the depth of their propagules is vitally obstructive.

Biology of weeds

Biology and habitat of few weeds are discussed below:

Bermuda grass

Cynodon dactylon is a perennial weed growing largely from rootstocks and stolons. Although it produces seeds, yet these are not important in its dissemination. Bermuda grass rootstocks form dense sod inside the soil and its stolon creep over the land ,extensively. The grass grows round the year but vigorous under warm and moist conditions.

Diagram

Nutsedge *(Cyperus* spp.)

There are two common species of nutsedge,namely,*Cyperus esculentus* L(yellow) and **C.** *rotundus*(purple).A purple nutsedge plant possesses a prominent basal bulb just below the ground level .This basal bulb produces a chain of tubers which ramify as deep as 60 cm in the soil. But in yellow nutsedge, instead of basal bulb there are crown buds a little below the soil surface which give rise to cluster of short rhizomes ending in small tubers. When mother shoots of yellow nutsedge are destroyed by tillage, new aerial shoots are borne by these crown buds.

Chief mode of propogation of yellow nutsedge is from seeds(nuts). Its tubers are small and slow growing.During the first one month of purple nutsedge, a mother tuber can produce four daughter tubers, and in three months the tuber population may reach almost 100. This makes purple nutsedge much more problematic than yellow nutsedge.

Diagram

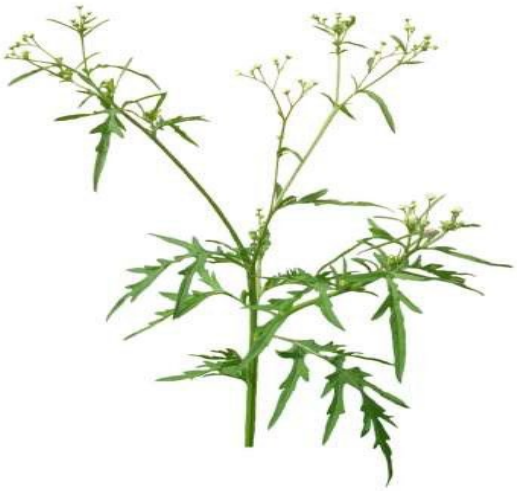
Carrot grass (*Parthenium hysterophorus*)

Carrot grass is an annual plant,with wide amplitude of ecological adaptability;being both photo and thermo insensitive.It reproduces itself freely from numerous seeds(5000-10000 per plant). When mother plant is cut , its cropwn bud produces new shoots.

The weed is notorious for causing allergic dermatitis and mental depressions in human beings.The main toxin responsible is parthenin. In summers , carrot grass tends to stunt its growth and remain in rosette form.It shoots up new growth in the rainy season and

grows fast through the winters, attaining a height oup to 90 c, with profuse branching The plant flowers and sets seeds throughout its growing period.

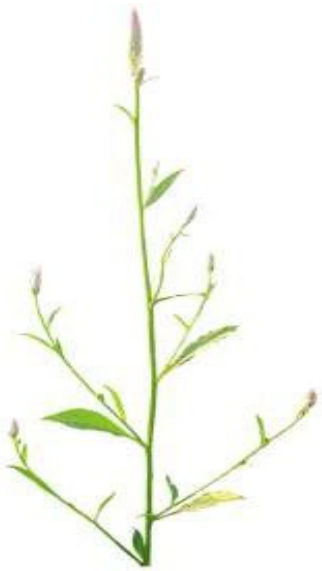
Diagram



Safed murga (*Celosia argentia*)

It is a herbaceous annual weed. It propogates through seeds which germinate with the onset of rains. The inflorescense is pinkish- white and can be recognized from a distance in a crop field. The plants have numerous lateral roots just a few centimeters below the soil surface which enable efficient absorption of nutrients from the soil. The plant has shallow root system.

Diagram



Ex. 1 Different methods of sexual and vegetative propagation of important weeds

Weed species	Common name	Propagation methods
Annuals / biennials Perennials		

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Exercise 3 Date……

Collection and preparation of weed herbarium

Introduction

Weeds are the unwanted plants at a given place. Weeds account for nearly 33 per cent of total annual loss of agricultural produce in India. Collection of weeds is essential so that one can know about their growth, development, competition and management under field conditions.

Objectives

(i) To know about the common weeds,

(ii) To learn about collection of weed specimen and preparation of herbarium.

Materials

Herbarium sheets, wooden block press, old newspapers, pencil or marker, thread etc.

Procedure

The scientific method of weed collection and preparation of herbarium consists of the following important steps :

1. Collection of plant sample from field

A scientifically collected weed specimen should contain all parts of plant including root, stem, leaves, flowers, fruits etc. For good identification, no part of the plant should be excluded. If plants are too small or large, extra care may be taken in collecting the specimen. A large plant may be divided into 2,3 or more sections, each pressed separately. However, excess branches or leaves may be removed provided remaining leaves and branches truly represent the plant. If the plants are very small, more number of specimen of the sample plant should be collected.

2. Pressing and drying of collected specimen

Once the weed specimen is rooted out at right stage (at seedling, flowering and fruiting), it is necessary to press it and fit well inside the limits of folded sheets of paper. Plants with long stem or leaves may be folded into V, N or W bends but should not be doubled back in such a way as to lie across itself.

3. Mounting on herbarium sheet.

Well pressed plant sample should be mounted on the herbarium sheet with the help of cello tape at the centre of the sheet.

4. Preparation and fixing of identification label : It consists of following two steps :

(A) Collection of information

The collector of weed specimen should record maximum useful information at the time of the collection. The data may be written either on the edge of same newspaper in which weed specimen will be brought from field to laboratory or a diary may be used citing some reference number for a particular weed specimen. The collector should record information in respect of the following parameters.

1. **Location** : Name of the village or town nearby the field and its distance and direction from the known town for exact location, the district may be mentioned..
2. **Date** : The date should be clearly mentioned with day, month and year. It should be written as March 15, 2008.
3. **Habitat** : Under this category, name of place with ecological conditions viz., field, pasture, roadside weeds, hillside, sand dune, nallah (eroded stream), light exposure (sun or shade), moisture conditions (dry, moist, wet. etc.) and denseness of community (bare ground, thin or dense population) should be pointed out.
4. **Occurrence of weeds** : A weed under consideration should be described in relativity of number of other species of weeds. For this purpose, an arbitrary scale of comparison using terms like rare, occasional, frequent, common and abundant may be followed.
5. **Noting of essential characteristics**

Nature	-	Annual, biennial, perennial
Root	-	Tap, fibrous, adventitious, shallow, deep
Stem/branches	-	Woody, herbaceous, erect, spreading, trailing, prostrate
Leaves	-	Simple, compound, narrow, broad
Flower	-	Shape, colour, fragrance

6. **Features of special reference** : Some plants in nature are known for their special characteristics in terms of fragrance, colour, leaf curling, stinging hairs, double colour of leaves, milky juice of stem or leaves, habitat of growth, stickiness etc. The specific characteristics of plant along with right stage of growth and development of the plant should be mentioned.

7. Miscellaneous points of interest : A collector by his own wisdom or discussion with local people may collect valuable and rare information about a weed specimen. This includes special use, preference shown by insect-pest, industry etc., special control measure, any thing special about dissemination and propagation etc.

B. Format of identification label

A scientific identification label should include the following points

	LABEL	Ref. No. …
State	:	
District	:	
Location and Habitat	:	
Common name (English)	:	
(Local)	:	
Scientific name	:	
Description	:	
Collectors Address	:	
Date & Time	:	

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Exercise 4 Date……

Classification of herbicides

Introduction

Any chemical used for weed control is called as weedicide or herbicide. Herbicides belonging to one chemical family tend to have similar modes of action on plants and behaviour in soils. Therefore, to have systematic understanding of possible behaviour of new herbicides belonging to a particular group or family, the classification of herbicides is essential.

Objectives

To become familiar with different groups or families of herbicides.

Classification of herbicides

1. Based on chemical structure

Inorganic herbicides – Inorganic herbicides do not contain carbon atoms in their molecules, For example, Arsenic acid, sulphuric acid, sodium arsenate, sodium chlorate, borax, copper sulphate.

Organic herbicides – Organic herbicides contain carbon atoms in their molecules. They may be oils or non oils. Majority of the present day herbicides are organic compounds which are non oils.

2. Based on selectivity

Selective : Selective herbicides kill only targete plants or weeds while crops are not affected eg. Simazine, altrazine, 2,4-D, MCPA, butachlor, alachlor, fluchloralin etc.

Non-Selective : Non-selective herbicides kill all vegetations that they come in contact with irrespective of whether it is a crop or weed, e.g. Paraquat and diquat.

3. Based on translocation

Systemic – Systemic herbicides move within the plant either through xylem or phloem. Most of the herbicides are selective at recommended rates, Example, Altrazine, simazine, 2,4-D etc.

Contact herbicides kill plants when they come in contact with plants. They kill the part of the plant that is in contact with herbicides eg. Paraquat, diaquat.

Classification of herbicides

Common name	Trade name	Structural formula
1. Aliphatic acids		
Dalapon	Dowpon, Tofapon	2,2-dichloro propionic and
TCA	Varitox	Trichloro acetic acid
2. Anilides and amides		
Alachlor	Lasso	2-chloro 2,6-diethyl N (methoxy methyl) acetanilide
Butachlor	Machete	N- (Butoxymethyl)-2 chloro-2^1,6^1 ethyl acetanilide
Propanil	Stam F-34, Rogue	3-4-dichloro propionanilide
3. Anilines and nitro-phenols		
Trifluralin	Treflan	2,6-dinitro-NN-dipropyl-4-trifluralin methylaniline
Fluchloralin	Basalin	N-propyl-N-(2- chloroethyl)-2,6-dinitro-trifluroethyl)-2-6 dinitro-triflurolin ethyl-aniline
Nitrofen	TOK E-25	2,4-dichlorophenyl nitrophenyl ether
4. Arsenicals		
DSMA	Ansar 184	Disodium methyl arsenate
MSMA	Ansar 529	Monosodium methyl arsenate
5. Benzoics and Phenyl acetic acid		
Dicamba	Banvel-D	2,3,6-trichlorophenyl acetic acid
Oxyfluorfen	Goal	2-chloro-1 (3 ethoxy-4-nitrophenoxy)-4 (trifluro methyl) benzene
6. Carbamates and thio carbamates		
Barban	Carbyne	4chloro-2-butynyl m-chloro-carbanilate
EPTC	EPTAM	s-ethyl diprophyl thiocarnbamate
Glyphosate	Round up	N (Phosphono methyl) glycine
7. Heterocyclic compound		
Diquat	Reglone	1,1-ethylene-2,2 bi pyridylium dibromide
Paraquat	Gramoxone	1,1, dimethyl-4) 4-bipyridylium dibromide
Altrazine	Atrataf	2-chloro-4 (ethyl amino)-6 (isopropyl amino)-S-triazine

Simazine	Gesatop	2,chloro-4,6 bis (ethyl amino)-S triazine
Metribuzin	Sencor	4-amino-6-tert-butyl 3 (methyl-thio) s-triazine-5 (4+1) one
8. Hormone type herbicides		
A. Phenoxy acetic acids		
2,4-D	Weedox, weedone	2,4-dichloro phenoxy acetic acid
2,4-5-T	Brush killer	2,4,5-trichloro phenoxy acetic acid
B. α phenoxy propionic acids		
Dichlorprop	2,4-DP	α-(2,4-dichlorophenoxy) propionic acid
Silvex	Fenoprop	2-(2,4,5-trichloro phenoxy) propionic acid
Mecoprop	MCPP	(4-chloro-2-methyl phenoxy) propionic acid
C. r – phenoxy butyric acids		
2,4-DB	Butaxone	(2,4-dichloro phenoxy) butyric acid
MCPB	Tropotox	(4-dichloro-2-methyl phenoxy) butyric acid
9. Substituted ureas		
Diuron	Karmex	3-(3,4-dichloro phenyl) dimethyl urea
Fenuron	Urab	1,1-dimethyl-3-phenyl urea mon (trichloro acetate)
Monuron	Telvar	3(P-chlorophenyl)-1,1- dimethyl urea
Linuron	Loxox	3 (3,4-dichloro phenyl)- methoxy –1- methyl urea

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Exercise 5 Date……

Study of herbicide spray equipments

Introduction

A spray is defined as liquid discharged in particles and scattered as dispersed droplets. Sprayer is an appliance which atomizes the spray fluid which may be a suspension, an emulsion or a solution. Different sprayers for different purposes and conditions are available in the market. Knowledge of sprayers is essential for effective application of herbicide and their proper maintenance.

Kinds of sprayers

Knapsack sprayers

They are loaded on the back of the worker during operation. Usually they carry metallic tanks but nowadays also available in plastic tanks. There are three types of knapsack sprayers (i) Hydraulic sprayers (ii) Manual pneumatic sprayers and (iii) Motorized pneumatic sprayers.

Foot sprayers

Foot sprayers are very popular for application of herbicides on comparatively large holdings. The pump lever of a sprayer has a pedal. The sprayer has provision for 1-2 delivery hoses.

Tractor powered

Tractor mounted sprayers work under a spray pressure of 1.4-2.8 kg/cm^2. It is very useful equipment for large holding farmers. Tractor mounted sprayers give high uniformity of the spray and utilization of tractor during idle time.

Objective

To become familiar with herbicide spray equipments.

Materials

1. Different types of sprayers with different capacity.
2. Nozzles : Hydraulic, flat fan, cone nozzle (hollow cone and solid cone), centrifugal and pneumatic nozzle.
3. Measuring containers, buckets and graduated cylinders.
4. Metre tape, metre stick, pressure gauge.

Procedure

Prepare a list of sprayers available in the laboratory and make drawings of all sprayers naming their parts. Similarly, drawings of nozzles and their spray pattern schedule be made. Students should operate sprayers filled with water, note down the spray pattern and spray angle with different nozzles. Observe the spray pattern and angle by spraying over dry soil. Spray output with different sprayers and operating pressures will be measured by collecting the water from the nozzles over constant period of time. Leakage and un- uniform spray pattern will be noted using worn out nozzles.

Result

1. Write down the components of a sprayer and their functions (Table 1)
2. Classify the sprayer according to spray volume into suitable category (Table 2).
3. Collect data on different pressures and nozzle types (Table 3 & 4).
4. Record the necessary information about a sprayer and its use (Table 5).

Table 1 Components of an ideal sprayer and their functions

S.No.	Components	Functions
1	Tank	To contain spray fluid
2	Agitator	To keep the material in tank uniformly dispersed by mechanical stirring
3	Filters	To strain off dirt and coarse particles
4	Pump	To feed the spray fluid to delivery tubes and nozzles or to deliver fluids under pressure
5	Power source	To provide power to power operated sprayer
6	Pressure gauge	For adjusting the pressure required for spraying
7	Valves	To maintain direction of flow of the spray fluid
8	Hose	To deliver spray fluid from the sprayers to lance or from container to the sprayer (in case of no built- in tank)
9	Spray lance	Brass tubes screwed to hold nozzles
10	Spray cut off devices	To shut off flow of liquid
11	Booms (spray bar)	A horizontal tube to hold a number of nozzles simultaneously
12	Nozzles	To break up and disperse the liquid supplied from spray equipment in droplets and from spray

Table 2. Classification of spray volume as per Indian standard institute (ISI) norms

Class	Volume (lit./ha)	Droplet size (micron)	Nature of spray	Equipment
High volume	560 or >	> 400	Coarse	Hydraulic sprayer
Medium volume	56 to < 560	201-400	Medium	Hydraulic sprayer
Low volume	5.6 to < 56	101-200	Fine	Mist blower
Ultra low volume	0.56 to < 5.6	100	Mist	Micron sprayer or ULV sprayer
Ultra-Ultra low volume	< 0.56	< 50	Aerosol	Fogging machine, smoke and vapour generator

Table 3 Readings at different pressure settings

psi	Volume of water collected	Spray droplets	Spray pattern
10			
20			
40			

Table 4 Observations on nozzle types

Particulars	Flat fan	Full cone	Hollow cone	Flood fan
1. Draw the spray pattern				
a) Side view				
b) Top view				

Table 5 Necessary information about a sprayer and its use

1. Name of sprayer	:	Hydraulic knapsack sprayer
2. Manual or power operated	:	Manual
3. Parts of sprayer	:	Hydraulic spray, pump, tank, pressure gauge, mechanical, agitator, nozzle, lance, boom
4. Spray tank capacity	:	15.0 litres
5. Type of nozzle	:	Flat fan
6. Pressure required to operate	:	3-4 kg cm^{-2}
7. Spray volume	:	250 litres/ha
8. Area covered in one spray (By same tank full spray liquid)	:	600 m^2
9. Spray out put (area covered/man/day)	:	0.4 ha/man/day
10. Cost of spryer	:	Low cost
11. Drawback/demerit of sprayer, if any	:	Man gets tired due to use of both hands
12. Other related information, if any	:	It is a good sprayer for farmer with small holding,cheaper and easy to maintain

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Exercise 6 Date……

Calibration of herbicide spray equipments

Introduction

Generally, herbicides are applied in the form of solution. Process of finding out the exact quantity of water required for spraying unit area is called calibration. Sprayer is the basic equipment used for application of herbicides. Proper application of herbicide depends upon the proper adjustment of all the basic components of a sprayer. Spray pattern varies according to nozzle type, orifice size, spraying pressure, nozzle spacing and boom height. Therefore, for uniform spraying of herbicides with good efficiency, it is necessary to calibrate the amount of water to be applied, speed of walking, pressure to be maintained etc. The main aim of calibration is to adjust the application pressure and application speed (walking speed) to get the desired volume rate.

Objectives

To calibrate the spray equipments for required spray volume.

Materials

Sprayer (Knapsack), buckets, water, measuring tape, graduated cylinders, time clock.

Method of calibration

The method of calibration of a sprayer consists of following steps :

Step 1 : Preparation of sprayer

- Remove and clean the nozzle
- Rinse the pressure and fill up with clean water and build up pressure
- Flush pump, hoses and lance with the clean water after removing the nozzle and strainers.
- Readjust the nozzle and strainers.
- Refill tank
- Now sprayer is ready for spray operation

Step 2 : Determination of nozzle discharge

- Keep the sprayer on the ground, fill up it with water and build up pressure
- Now take a bucket and dip the nozzle in it. Spray water for 5 minutes into bucket. Shut off the valve exactly at the end of five minutes.

- Measure volume of water collected in bucket with the help of graduated cylinder
- Repeat the operation for three times.
- Determine the average reading. This is the nozzle discharge or flow rate expressed in litres / minute.

Step 3 : Determination of spray volume

Measure and mark an area of 50 sq.m with the help of a measuring tape. Spray the water in this measured area of 50 sq.m. Determine the volume of spray delivered from the tank.

Step 4 : Determination of walking speed

- Mark a starting point on bare soil surface with a stick.
- Adjust the prepared sprayer on the back and operate pumping, directing lance and nozzle within spray swath.
- Walk at a normal and constant speed exactly for five minutes.
- Measure the distance covered in five minutes.
- Repeat the operation for three times.
- Express the average walking speed in metres /minute.
- Do the same operation in the crop planted field and determine the average walking speed.

Step 5 : Determination of swath

Mark in the field an area having width equal to the swath (the distance up to which the spray falls on the ground on a fixed height). The spray lance could be held constant while walking forward but could be swung from left to right.

Step 6 : Observation

For proper calibration of a sprayer, following observations should be recorded.

a) Total distance travelled = d metre
b) Time taken for travelling distance ‘d’ metres = t min.
c) Swath width = x metres
d) Amount of water discharged at a given pressure = L litre.

Calculation

A. Spray volume

$$\text{Spray volume (L/ha)} = \frac{\text{Water used in testing (litres)} \times 10000}{\text{Area covered during test run } (m^2)}$$

$$= \frac{L}{d \times x} 10000$$

Example : If 50 metres were covered while spraying a solution (water) of 4 litres with a swath width of 1 metre, the volume required for one hectare would be :

$$= \frac{4 \times 10000}{50 \times 1} = 800 \text{ litres} \quad (1 \text{ ha} = 10{,}000 \ m^2)$$

B. Area covered per hour by sprayer

$$\text{Area sprayed } (m^2 / \text{minute}) = \text{width of spray swath (m)} \times \text{walking speed (m/min)}$$

$$\text{Area (ha/hr)} = \frac{\text{Walking speed (km /hr)} \times \text{m / km} \times \text{Walking speed (m /min)}}{m^2 / \text{ha}}$$

or

$$\text{Area (ha/hr)} = \frac{\text{WS (m /hr)} \times \text{Swath (m)}}{10{,}000}$$

C. Pump capacity of a sprayer

The rate of discharge of a sprayer per unit time can be calculated by following formula :

$$\text{Pump capacity (L /hr)} = \frac{\text{Spray volume (L/ha)} \times \text{Swath width (m)} \times \text{Walking speed (m/hr)}}{10{,}000}$$

Example : If a person is walking at 2 km/hr covering a swath of 1 m width, with a spray discharge rate (pump capacity) 100 litre s/hr, then calculate the area covered (ha) per hour, time taken (hr) to cover an area of one hectare and spray volume required for an area of one hectare

(a) Area covered per hour $= \frac{2 \times 1000 \times 1}{10000} = 0.2$ ha /hr

(b) Time required to cover one hectare $= \frac{1}{0.2} = \frac{10}{2} = 5$ hrs

(b) Spray volume for one hectare = Discharge rate (L /ha) x Time required for spray (hr) x Area (ha)

$= 100 \times 5 \times 1 = 500$ litres /ha

Example : Find out the spray volume in litres /ha if the pump capacity is 50 litres / minute, swath width is 5 m and walking speed is 10 km/hr.

$$\text{Pump capacity (L /hr)} = \frac{\text{Spray volume (L /ha)} \times \text{Swath width (m)} \times \text{Walking speed (m /hr)}}{10{,}000}$$

$$\text{So, spray volume (L /ha)} = \frac{\text{Pump capacity (litres /hr)}}{\text{Swath width (m)} \times \text{Walking speed (m/hr)}} \times 10{,}000$$

$$= \frac{50 \times 60 \times 10{,}000}{5 \times 10{,}000} = 600 \text{ L /ha}$$

Problem 1

What minimum size of pump is required to apply a spray at 90 L/ha with sprayer travelling at 8 km /hr and equipped with a 8 m long boom.

Solution

Given spray volume = 90 l /ha

Walking speed = 8 km /hr

Spray swath = 8 m

Pump capacity (l /m) = ?

$$\text{Pump capacity (l /minute)} = \frac{\text{Spray volume (L /ha)} \times \text{Swath width (m)} \times \text{Walking speed (m /hr)}}{10{,}000 \times 60}$$

$$= \frac{90 \times 8 \times 8{,}000}{10{,}000 \times 60} = \frac{48}{5} = 9.6 \text{ L/m}$$

Problem 2

A tractor drawn sprayer is walking at 10 km /hr covering swath width of 2 m, with a spray discharge rate of 50 L/ha. Calculate the area covered per hour, time taken (hr) to cover an area of 5 hectares and spray volume required for the same area.

Solution

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Exercise 7 Date……

Calculation on herbicidal requirement for field crops and aquatic situations

Introduction

Requirement of a herbicide depends upon the type of herbicide, formulation, per cent of active ingredient, area to be sprayed and volume of water. Further, the method of calculation of herbicide dose will be different for aquatic situation (water body) in comparison to unit area of land.

Objective

To calculate the requirement of herbicide formulations for field crops and aquatic situations.

Materials

Herbicide formulation, area to be treated (pond area or land surface) measuring tape, weighing balance, given numericals etc.

Procedure

(a) Herbicide requirement for field crops

All the herbicide recommendations are based on active ingredient (a.i.). Once the a.i. is known, herbicides requirement can be determined by applying the following formula :

$$\text{Quantity of herbicide (kg/ha)} = \frac{\text{Recommended dose (kg a.i/ha)} \times \text{Area to be treated (ha)}}{\text{\% a.i. in the formulation}} \times 100$$

Example 1. Determine the quantity of Glycel 41SL required to treat 2 hectares of land, if the recommendation of glyphosate is 0.5 kg a.i. /ha.

Solution

$$\text{Quantity of Glycel} = \frac{0.5 \times 2}{41} \times 100 = 244 \text{ kg} \quad (\text{glycel contains } 41\% \text{ a.i.})$$

Example 2 A herbicide contains active ingredient of 0.4 kg/litre and the desired rate of application is 1.5 kg/ha. Calculate the quantity of herbicide required for 1 ha.

Solution

$$\text{Quantity of herbicide formulation} = \frac{1.5}{40} \times 100 = 3.75 \text{ litres}$$

Note : 0.4 kg a.i./litre = 40% a.i.

(B) Calculation of quantity of herbicide for aquatic weeds

For different aquatic situations and nature of weeds, herbicide requirement may be determined as under :

(i) For emerged, marginal floating weeds growing in stagnant water : In this situation, surface area of pond/lake to be treated is important.

$$\text{Quantity of herbicide (L/ha)} = \frac{\text{Surface area } (m^2) \times \text{Spray volume (L/ha)} \times \text{Herbicide concentration (\%)}}{10{,}000 \times 100}$$

Example : Calculate the quantity of Gramoxone required to control emerged weeds in a pond, having an area of 5000 sq metres. Weeds are to be treated with 0.5% of Gramoxone (paraquat) at a spray volume of 800 litres /ha.

Solution

$$\text{Quantity of Gramoxone} = \frac{5000 \times 800 \times 0.5}{10{,}000 \times 100} = 2 \text{ litres}$$

(ii) For submerged weeds in stable water bodies : In this situation, inspite of surface area, total volume of water in a pond or water body is taken as a basis of total herbicide requirement.

$$\text{Quantity of herbicide} = \frac{\text{Surface area of Water body } (m^2) \times \text{Depth of water in water body} \times 10.11 \times \text{Herbicide dose (ppmw)}}{10000}$$

ppmw = parts per million weight

or

$$\text{Quantity of herbicide} = \frac{\text{Volume of water } (m^3) \times 1011 \times \text{Herbicide dose (ppmw)}}{10^6}$$

Example : Calculate the amount of 2,4-D required to control weeds in a pond with 4000 m^2 surface area and 1.0 metre water depth. The rate of application of 2,4-D is 0.5 ppmw.

$$\text{Quantity of 2,4-D} = \frac{4000 \times 1 \times 10.11 \times 0.5}{10{,}000}$$

or

$$\text{Quantity of 2,4-D} = \frac{4000 \times 1011 \times 0.5}{10^6} = 2.02 \text{ kg}$$

(iii) For submerged weeds in flowing water bodies :Weeds also grow in canals and channels. Water flows in canals and channels and, hence, under this situation, the quantity of herbicide is based on the water discharge rate and dimensions of the ca nal or channel. Therefore, first calculate the water discharge rate of stream and then determine the requirement of herbicide.

Application of spray herbicide (litres/minute) (cumec.) = Rate of herbicide application (litres/minute) x Discharge rate of stream

Discharge rate of stream (cumec.) = Width of canal (m) x Depth of canal (m) x Flow speed (m/sec.) x 0.9

Example : A canal with a dimension of 25 m width and 1.5 m depth is to be treated with a spray solution of 200 litres in 90 minutes to control weeds. Canal is flowing at a speed of 0.8 m/sec. Calculate the application rate of the herbicide solution.

Solution

(i) Discharge rate of water in canal = 25 x 1.5 x 0.8 x 0.9 = 27 m^3 /sec.

(ii) Application (injection) rate of herbicide solution = $\frac{200 \times 27}{90}$ = 60 litres/min.

Problem 1 : Calculate the quantity of commercial material required to spray 5 hectares of wheat crop with a solution of 6000 ppm of 2,4-D available in ester and amine forms. The a.i. present in ester is 400 g/l and in amine is 500 g/l., the recommended doses are 0.25 and 0.5 kg ha^{-1} for ester and amine, respectively.

Solution

Problem 2 : A,B and C are three different herbicides available in the market with the following informations

	Herbicide A	Herbicide B	Herbicide C
a.i. present(%)	45	60	75
Recommended dose (kg a.i./ha)	1.50	1.25	0.40
cost (Rs/kg)	225	240	400

Report which herbicide you will recommend for controlling weeds in wheat crop**.**
Solution

Problem 3 : Calculate the amount of 2,4-D required to control the weeds in a pond of 3500 m^2 surface area and 1.5 m water depth. The rate of application of 2,4-D is 0.6 ppmw (parts per million weight).

Solution

Signature of Faculty In-charge