



**Biotica
Research
Today**
Vol 4:8
2022

579
582

Herbicide Options for Maize Cultivation in India

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Open Access

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Keywords

Half-life, Rainfast, Restricted entry interval, Weed infestation

Article History

Received on: 05th August 2022

Revised on: 15th August 2022

Accepted on: 16th August 2022

E-mail: bioticapublications@gmail.com

How to cite this article?

Govindasamy *et al.*, 2022. Herbicide Options for Maize Cultivation in India. *Biotica Research Today* 4(8):579-582.

Abstract

In India, the recent times herbicide-based weed management is getting popular due to the lack of labour and the adoption of zero tillage systems. Particularly, the wider-spaced (60 cm row to row) crops like maize. Along with the selection and application of herbicides; the farmers should have a thorough knowledge of how to read the label, use of personal protective equipment, and some of the terminologies that help in the protection of human health, enhance the efficiency of herbicides, and prevent soil and environmental pollutions are very much important. By considering the above points, in this article, we have briefly covered each point of herbicides used in maize. We believe that this article would help farmers, students, and scientists working in the field of weed management.

Introduction

Maize is an important cereal crop grown for grain, fodder, and industrial (corn starch and oil) purposes. It is grown in all three seasons of India *i.e.*, *kharif* (rainy), *rabi* (winter), and *zaid* (summer) but predominantly (85%) is a rainy season crop. In India, maize is considered the third most important crop after rice and wheat. It is cultivated in almost all the states of India (Figure 1). The states such as Karnataka, Rajasthan, Andhra Pradesh, and Madhya Pradesh occupy half of the total cultivated area (Figure 1). Five states Karnataka, Andhra Pradesh, Maharashtra, Rajasthan, and Bihar contribute 75% of the total production (Anonymous, 2022a).

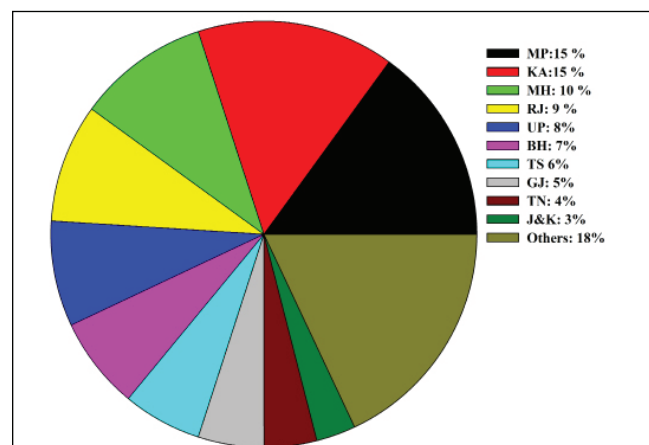


Figure 1: Percent maize area contribution of different states of India (Source: Anonymous, 2019)

Weed Infestation

The type of weed species in maize varies depending on the type of soil, crop state (irrigated and rain-fed), and location of the study (Table 1). Farmers should select suitable herbicides for weed control according to the weed species. For example, if the field is infested only with narrow

Table 1: Soil type influenced the type of weed species

Soil type	Grass weeds	Broadleaf weeds	Sedges
Sandy loam	<i>Acrachne racemosa</i> , <i>Dactyloctenium aegyptium</i> and <i>Setaria viridis</i>	<i>Trianthema portulacastrum</i> , <i>Commelina benghalensis</i> and <i>Digera arvensis</i>	<i>Cyperus rotundus</i>
Sandy clay loam texture	<i>Cynodon dactylon</i> , <i>Digitaria marginata</i> , <i>Digitaria sanguinalis</i> , <i>Panicum repens</i> , <i>Eleusine indica</i> , <i>Dactyloctenium aegyptium</i>	<i>Ageratum conizoides</i> , <i>Alternanthera phyloxiroides</i> , <i>Bidens pilosa</i> , <i>Borrevia hispida</i> , <i>Galinsoga parviflora</i> , <i>Spilanthes acemella</i> , <i>Trianthema portulacastrum</i> , <i>Cleome gynandra</i> , <i>Digera arvensis</i> , <i>Datura stramonium</i> , <i>Commelina bengalensis</i>	<i>Cyperus rotundus</i> and <i>Fimbristylis miliacea</i>
Clay	<i>Cynodon dactylon</i> , <i>Dinebra arabica</i> , <i>Panicum spp.</i> , <i>Ischaemum pilosum</i> , <i>Digitaria sanguinalis</i> , <i>Dinebra retroflexa</i> , <i>Poa annua</i>	<i>Xanthium strumarium</i> , <i>Celosia argentea</i> , <i>Tridax procumbens</i> , <i>Phyllanthus niruri</i> , <i>Portulaca oleraceae</i> , <i>Lagasca mollis</i> , <i>Euphorbia geniculata</i> , <i>Euphorbia hirta</i> , <i>Abutilon indicum</i> , <i>Abelmoschus moschatus</i> , <i>Boerhavia diffusa</i> , <i>Calotropis gigantea</i> , <i>Ageratum conyzoides</i> , <i>Bidens pilosa</i> , <i>Mimosa pudica</i> , <i>Alternanthera triandra</i> , <i>Parthenium hysterophorus</i> , <i>Digera arvensis</i> , <i>Amaranthis viridis</i> , <i>Commelina benghalensis</i> , <i>Cyanotis axillaris</i>	<i>Cyperus rotundus</i>

leaf weeds, then the farmer has to select the grass active herbicides and vice versa for broad leaves and sedges. In most cases, the field is infested with broad-spectrum weeds, which forces the farmer to apply broad-spectrum herbicides.

Herbicide Options for Maize

Many herbicide options are available for maize and a few are old-generation herbicides but many are new-generation herbicides. The new generation molecules are needed in a lesser quantity and most of them are broad-spectrum with very good activity on *Cyperus* species (Table 2).

Persistence (Half-life)

The duration of an herbicide that remains active in the soil after the application is referred to as “soil persistence,” or “soil residual life” or “half-life”. This is dependent on the soil factors (soil composition, soil chemistry, and microbial activity), climatic factors (moisture, temperature, and sunlight), and herbicide properties (water solubility, vapor pressure, and the susceptibility of herbicides to chemical or microbial alteration or degradation). The practical utility of knowing the persistence of individual herbicides used in maize is important for choosing the rotational crops (Table 3).

Table 2: Herbicides are recommended for maize (Source: Shaner, 2014)

Herbicide	Time of application	WSSA* Group number	Mode of action	kg* a.i.* ha ⁻¹	kg or ml* ha ⁻¹	Water requirement	Trade names	Spectrum of control
Atrazine (50% WP*)	PRE* or POE*	5 (C ₁)	Photosystem-II inhibitors (PS-II)	1.0	2.0 kg	500 L*	Many (Atranex, Atrataf, Atragold etc.)	Broad spectrum
Pendimethalin (30% EC*)	PRE	3 (K ₁)	Microtubule assembly inhibitors	1	3.33 L	500 L	Many (Stomp, Panida, Pendistar etc.)	Small seeded broad leaves and grasses
2,4-D EE* (38% EC)	POE	4 (O)	Auxin herbicide	0.75	1.98 L	400 L	Many (Fighter, Slayer etc.)	Broadleaves
Halosulfuron (75% WG)	POE	2 (B)	ALS* enzyme inhibitors	0.06	0.08 kg	400 L	Sempre, Deca-Kill	Cyperus Spp.
Topramezone (33.6% SC*)	POE	27 (F ₂)	HPPD* inhibitors	0.025	0.074 L	400 L	Tynzer, Elite	Broad spectrum

Herbicide	Time of application	WSSA* Group number	Mode of action	kg* a.i.* ha ⁻¹	kg or ml* ha ⁻¹ *	Water requirement	Trade names	Spectrum of control
Tembotrione (42% SC)	POE	27 (F ₂)	HPPD inhibitors	0.120	0.285 L	400 L	Laudis	Broad spectrum
Tank mix								
Pendimethalin + Atrazine	PRE	5 (C ₁) and 3 (K ₁)	Microtubule assembly inhibitors and PS-II	0.75 and 0.75	2.5 L and 1.5 kg	500 L	-	Broad spectrum
Tembotrione + Atrazine	POE	27 (F ₂) and 5 (C ₁)	HPPD and PS-II inhibitors	0.120 and 0.50	0.285 L and 1 kg	400 L	-	Broad spectrum
Topramezone + Atrazine	POE	27 (F ₂) and 5 (C ₁)	HPPD and PS-II inhibitors	0.025 and 0.50	0.074 L and 1 kg	400 L	-	Broad spectrum

*WSSA - Weed Science Society of India; kg - kilogram; ml - millilitre; ha - hectare; WP - wettable powder; EC - emulsifiable concentrates; PRE - pre-emergence (within 3 days after sowing); POE - post-emergence (15-25 days after sowing); L - litre; a.i. - the active ingredient; EE - ethyl ester; WG - wettable granule; ALS - acetolactate synthase; HPPD - 4-hydroxyphenylpyruvate dioxygenase; SC - suspension concentrate

Table 3: Persistence of maize herbicides (Source: Anonymous, 2018 and Anonymous, 2022b)

Herbicides	Persistence (Half-life) (days)	Rain-fast period (hr)	Restricted entry-level (hrs)	Waiting period (days)	Rotational crops
Atrazine	60	Heavy rain immediately after application results in excessive concentration on the furrows that leads to crop injury.	12	60 days for maize; 45 days for baby corn; 21 days for grazing the animals.	Avoid rotation of soybean, sugar beets, tobacco, and vegetables.
Pendimethalin	44	-	24	60 days for cotton; 21 days for grazing the maize.	Avoid sugar beets, red beets, proso millet, and spinach cultivation within 12 months after application. Avoid wheat and barley cultivation within four months.
2,4-D EE*	7-28	1	-	-	7-14 days for corn; 29 days for sorghum; 7-15 days for soybean; 29 days for small grains; and 30 days for other crops.
Halosulfuron	4-34	4	12 hr	-	2 months for sorghum, forage grasses, barley, and wheat; 9 months for peas.
Topramezone	14	4	12 hr	-	Wait 18 months for crops not listed on the label; 9 months for sorghum, alfalfa, and soybean; 3 months for Wheat and barley.
Tembotrione	14.5	1	12 hr	55 days	10 months for sorghum, alfalfa, and soybean; 9 months for Wheat and barley.

Rainfast Period

A rain-free period is required after the application of herbicides is called a rainfast period. The rain that occurred within the prescribed period can reduce the efficacy of the herbicide or cause injury to the crop. Rainfast days of herbicides used in maize are given in Table 3.

Restricted Entry Interval

The restricted entry interval (REI) is a period after the application of an herbicide. During this period the labours must be restricted to enter the treated area. This period would vary from herbicide to herbicide. The prescribed REI of herbicides used in maize is given in Table 3.

Waiting Period

This is a period to consider for harvest interval or harvest consideration of crops for grain or forage purposes. The waiting period is based on the residue level of herbicides. The majorly is applicable for post-applied herbicides (Table 3).

Tips for Successful Weed Management

- Follow the label direction of herbicides.
- Use only the recommended dose of herbicide to avoid soil and environmental pollution, and the development of herbicide resistance.
- Use the well-working sprayer and nozzle (flat fan) for effective application.
- Thoroughly clean the sprayer before and after application (triple rinse the sprayer before and after application of herbicides or use strong detergent or commercial spray cleaners).
- Use Personal Protective Equipment (PPE) during the application of herbicides to avoid direct contact with herbicides.

- Avoid spraying herbicides during windy days.
- Select sunny days (avoid cloudy days) for herbicide application that will enhance the faster uptake of herbicide by weeds.
- Activate the soil-applied herbicides (pre-herbicides) with rainfall or irrigation, if the soil is dry at the time of application.
- Add surfactant or adjuvants as recommended by the label.

Conclusion

To get the complete benefit out of chemical weed management the farmers should understand all the prescribed label information of each herbicide before the selection and application. This will enhance the weed control efficiency, minimize the environmental hazards, and reduce the exposure of herbicides to applicators.

References

- Anonymous, 2018. Rain-free period for postemergence herbicide applications. pp. 180-181.
- Anonymous, 2019. India Maize Scenario. ICAR-Indian Institute of Maize Research, PAU Campus, Ludhiana, Punjab-141004, India. Available at: <https://iimr.icar.gov.in/india-maze-scenario/>. Accessed on: 30.07.2022.
- Anonymous, 2022a. Maize Vision 2022, A Knowledge Report. Federation of Indian Chambers of Commerce and Industry, India, pp. 1-85.
- Anonymous, 2022b. Herbicide Labels. CDMS Advanced Search. Available at: <https://www.cdms.net/Label-Database/Advanced-Search>. Accessed on 30.07.2022.
- Shaner, D.L., 2014. Herbicide Handbook (No. 632.954 W394h10). Weed Science Society of America, Lawrence, Kansas State, USA, pp. 1-513.