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Weed Management Techniques in Black Gram Fields

Chinmoy deori[1*], P. Chowdhury[2], Purabi Tamuli Phukan[3], joyshikh Sonowal[4], Rasen bey[5]

[1]SMS (Agronomy), KVK Sribhumi, Assam
[2]Senior Scientist and Head, KVK Sribhumi, Assam
[3]SMS, Horticulture, KVK Sribhumi, Assam
[4]SMS, Animal Science, KVK Sribhumi
[5]Farm Manager, KVK Farm Manager

*Corresponding Author
Chinmoy deori*

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INTRODUCTION

Black gram (*Vigna mungo*) or urad bean is one of the vital pulse crops grown throughout India and other regions of South and Southeast Asia. It is a vital crop in the provision of food security and soil enrichment because of its nitrogen-fixing properties. Nevertheless, one of the key challenges associated with the growth of black gram is infestation by weeds, which causes a substantial decrease in crop yield and quality as they compete for light, nutrients, water, and space, particularly when the plant is young.

Black gram weed control is essential since the crop possesses a slow early growth rate and is susceptible to early competition from weeds. Weeds can lead to yield loss of 30% to 60% if left uncontrolled. The present article offers a detailed review of various weed management methods such as cultural, mechanical, chemical, biological, and integrated approaches for efficient black gram field weed control.

2. Weeds of Black Gram Fields

Knowledge of the prevailing weed flora is necessary for planning effective control measures. Common weeds encountered in black gram crops are:

2.1 Broad-leaved Weeds

- *Parthenium hysterophorus* (Congress grass)
- *Amaranthus viridis* (Green amaranth)
- *Eclipta alba* (False daisy)

2.2 Grasses

- *Cynodon dactylon* (Bermuda grass)
- *Echinochloa colona* (Jungle rice)
- *Dactyloctenium aegyptium* (Crowfoot grass)

2.3 Sedges

- *Cyperus rotundus (*Nut grass)
- *Cyperus difformis*

Emergence of the weeds usually takes place during the initial 3–5 weeks following sowing, referred to as the critical period of competition between crop and weed.

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3. Weed Management Techniques

3.1 Cultural Practices

Cultural weed control practices are preventive, non-chemical methods that seek to alter the environment of the crop in a manner where it becomes less supportive of weed development. They are eco-friendly and sustainable and so are well-suited for organic production systems and smallholders.

a) Early Sowing: Sowing the black gram during the beginning of monsoon facilitates early germination and canopy formation, and the crop can cover the ground by out-racing the weeds for light, nutrients, and water.

b) Seed Rate and Row Spacing: With a greater seed rate of 20–25 kg/ha and optimal row spacing of 30 cm, there is increased early ground cover. Dense crop canopy covers the soil and prevents germination and growth of weeds.

c) Crop Rotation: Crop rotation using cereals like rice or wheat interferes with the life cycles of certain weeds. Rotational cropping inhibits the dominance of some of the weed species that become accustomed to repeated black gram planting.

d) Mulching: Applying organic mulches (such as crop residues, straw, or leaves) or plastic mulches retains soil moisture and checks weed germination by excluding sunlight. This process is particularly helpful in rainfed situations and ensures improved crop health.

3.2 Mechanical Means

Physical uprooting of weeds by manual methods or farm equipment represents mechanical means. The processes are effective, environmentally friendly, and assist in soil improvement in addition to weed management.

a) Hand Weeding:

It is the oldest and most commonly used method, particularly on small and medium-sized farms. It requires hand pulling of the weeds from the field of crops. Though effective, it is time-consuming and labor-intensive. For optimal performance, two hand weedings-the first being at 20 days after sowing (DAS) and the second at 40 DAS are widely suggested to avert weed competition during the vulnerable crop growth stages.

b) Hoeing and Intercultivation:

These are done with hand hoes or wheel hoes between the rows of crops. This not only weeds the inter-row area but also breaks the soil, increasing aeration and root extension. Hoeing is usually done in conjunction with irrigation to enhance soil structure as well as moisture retention.

c) Weeder Tools:

Basic weeder tools such as the conoweeder or dryland weeder enhance the efficiency of weeding as well as minimize physical effort for laborers. These are particularly effective where black gram is row-planted.

Limitations:

Mechanical approaches might not be feasible in large-scale or labor-deficient conditions and might prove expensive if labor is lacking or is costly.

3.3 Chemical Weed Management Methods in Black Gram

Chemical methods utilize herbicides for weed control and are regarded as quick, efficient, and cost-effective, especially in large-scale black gram production. They have to be applied with caution, however, so as to avoid crop damage, resistance to herbicides, and contamination of the environment.

a) Pre-emergence Herbicides:

Pre-emergence herbicides are used 2–3 days after sowing but prior to weed emergence. Pendimethalin at the rate of 1.0–1.5 kg a.i./ha is commonly applied to fields of black gram. Pendimethalin creates a chemical barrier on the soil surface, inhibiting the germination of annual grasses and broadleaf weeds, thereby guarding the crop during the initial growth period.

b) Post-emergence Herbicides:

Post-emergent herbicides are sprayed following the emergence of the crop and weeds, usually at 20–25 days after sowing (DAS). The most commonly used is imazethapyr (75 g a.i./ha) in black gram. It is legume crop selective and gives effective control against a wide range of grasses and broadleaf weeds without causing any damage to the crop.

c) Combination Products

Pendimethalin + Imazethapyr applied alone or sequentially offers longer and better weed control in black gram fields. It controls a broader spectrum of weed species and extends the period of suppression, thus minimizing the necessity for further treatments.

Precautions:

- Strictly adhere to directions on the label regarding dosage and timing.
- Avoid drift towards neighboring crops that are sensitive to herbicide.
- Wear Personal Protective Equipment (PPE) like gloves, mask, and goggles while mixing and application to maintain user safety.

3.4 Biological Methods

Biological weed control seeks to apply a biodegradable and non-toxic method of using the natural enemies of weeds—like insects, pathogens, or grazing animals—to control weed development. This process is intended to lessen weed populations without killing the crop or environment. Some examples that stand out include:

- *Zygogramma bicolorata*, a bug utilized in the management of the invasive weed *Parthenium hysterophorus.*
- Fungal diseases like Fusarium spp., which infect and downregulate some sedge species.

Although ecologically friendly and self-sustaining, biological approaches have limited utility in black gram production because they are slow-acting, selective to specific weeds, and require controlled environments for establishment to be successful. They presently perform a supplementary function and are better adapted to long-term weed suppression in particular circumstances rather than as alternatives.

3.5 Integrated Weed Management (IWM)

Integrated Weed Management (IWM) is an integrated approach that incorporates cultural, mechanical, chemical, and biological strategies to manage weeds efficiently while reducing adverse environmental and economic effects.

A routine IWM plan for black gram is:

- Cultural practices: Implement ideal seed rate and row spacing for early canopy formation.
- Chemical control: Apply Pendimethalin as a pre-emergence herbicide and Imazethapyr as a post-emergence spray.
- Mechanical practices: Carry out hand weeding at about 30 DAS, if necessary.

Benefits of IWM:

Prevents herbicide resistance.

- Keeps dependence on a single approach, making it sustainable for weed control.
- Minimizes the total chemical load on the environment.
- Economical in the long term and compatible with various farm systems.

4. Weed Management Schedule for Black Gram (Example)

Time After Sowing	Recommended Practice
0–3 DAS	Pendimethalin (1.0 kg a.i./ha)
20–25 DAS	Imazethapyr (75 g a.i./ha)
30 DAS	Hand weeding/intercultivation if necessary
45 DAS onwards	Crop canopy suppresses new weed emergence

5. Constraints in Weed Management

Black gram weed management is also burdened with various challenges that restrict its efficacy, particularly for marginal and small farmers. Shortages of labor during critical weeding seasons render timely mechanical or manual management challenging. Widespread application of chemicals is discouraged by high herbicide prices and restricted access to inputs. Awareness of effective weed control practices and safe handling of herbicides by many smallholders is lacking. Moreover, the frequent use of identical herbicide molecules has also

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created herbicide-resistant weed species. Environmental issues, including soil contamination and degradation, also originate from the excessive utilization of chemical herbicides, as such measures necessitate the application of integrated means.

6. Future Perspectives

The way of the future for black gram weed management is the incorporation of cutting-edge, eco-friendly, and technology-based methods. Breeding or genetic transformation to create weed-resistant black gram varieties can make a huge impact on the reduction of herbicide reliance. The merging of Artificial Intelligence (AI) and drone-assisted herbicide delivery systems allows for precision agriculture, which ensures controlled weed management with low chemical use.

For minimizing environmental influence, there has to be a stronger focus on the development of environmentally friendly biological control agents that provide long-term and sustainable weed control. Further, the programs of farmer training in Integrated Weed Management (IWM) and safe use of herbicides are necessary for enhancing adoption and reducing health hazards. State-of-the-art methods such as weed flora mapping and predictive models have the potential to predict weed outbreaks and facilitate timely and localized interventions. These methods, together, will make weed control in black gram more efficient, cost-effective, and eco-friendly.

CONCLUSION

Weed control in black gram should be effective to aim towards greater productivity, lower yield loss, and soil health maintenance. A single method being the sole reliance is not sustainable or effective in the long term. Therefore, an Integrated Weed Management strategy, which integrates cultural, mechanical, chemical, and biological techniques, should be followed. Equipping the farmers with training, low-cost technology accessibility, and region-specific advice will assist in attaining sustainable black gram production and enhancing rural livelihoods.

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